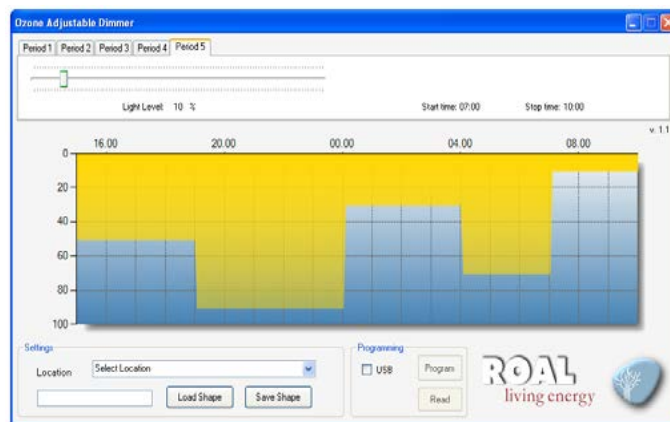




Adjustable dimmer User Manual

- Software installation
- Operative instructions



Introduction

The high grade of intelligence and flexibility behind OZONE led driver and the “Living Energy” philosophy undertaken by ROAL, permitted us to develop the most innovative and “environmentally friendly” constant current LED driver.

The aim of our work is energy saving. OZONE and its “Adjustable dimmer” feature are the result.

The “Adjustable dimmer” function permits a fast and easy custom outdoor lighting management, focused on large areas lighting applications, like parking lots, shopping centers and urban spaces, allowing companies or public organizations to optimize their costs taking care of the environment.

The “OZONE adjustable Dimmer” PC software supplied by ROAL permits to plan up to five (5) dimming levels for a custom night-light profile, worldwide time zones synchronized. By a USB connection, the customized light profile shape can be transferred in the OZONE Programming Tool (see AN3_Ozone setting) and then installed in the OZONE LED driver memory to be executed.

The self-updating OZONE’s embedded firmware determines the night real time without an internal real time clock. This means no battery inside, therefore no field maintenance.

Just turning the lighting fixture ON/OFF, the custom light profile shape will be self-synchronized to the real time zone, without any clock setting in the installation area.

1 Minimum PC Requirements and License Agreement

1.1 Operating System: Windows XP SP3 / Windows Vista / Windows 7
Microsoft.NET Framework 4 Client Profile (x86 and x64)

1.2 The "OZONE Adjustable Dimmer" PC software is property of ROAL Electronics S.p.a. and it is managed and distributed only by ROAL.

- The "OZONE Adjustable Dimmer" PC Sw can be installed in any number of computers.
- The "OZONE Adjustable Dimmer" program file can not be modified in any way.
- The "OZONE Adjustable Dimmer" can be distributed or sold exclusively by ROAL Electronics S.p.a.

The "OZONE Adjustable Dimmer" PC Sw and related documentation are provided without any kind of warranty. This SW does not warrant that its functions or documentation will meet your requirements or that the Sw operation will be error-free or complete, or that defects in the Sw or documentation will be corrected.

Under any circumstances, including negligence, the "OZONE Adjustable Dimmer" PC Sw and related documentation shall not be liable for any lost revenue or profits or any incidental, indirect, special, or consequential damages that result from the use or inability to use the Sw or related documentation.

ROAL Electronics reserves all the rights to change or modify the "OZONE Adjustable Dimmer" PC Sw and related documentation without notification.

Contact ROAL Sales Engineering Department to get the latest SW revision.

2 Software installation procedure

2.1 Unzip "OZONE Setup Files.zip" in your dedicated PC folder, two subfolders will be generated "Ozone Adjustable Dimmer" and "usb Driver".

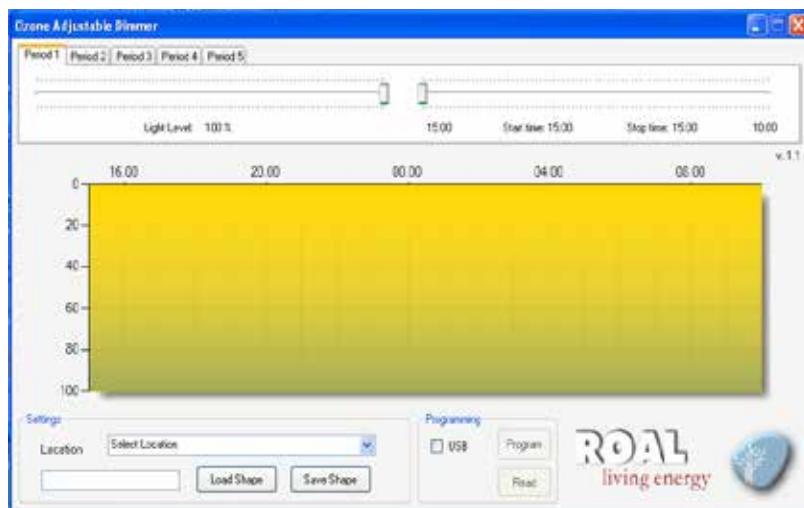
2.2 Enter the "Ozone Adjustable Dimmer" folder and launch the "Setup" file.

It is required to install the "Microsoft .NET Framework 4 Client Profile (x86 e x64)" in your PC system. If it is already installed in you computer, the procedure will automatically continue. If not, the installation procedure will directly download it from the Microsoft website (it could take some minutes and requires the system restart).

2.3 Once the Microsoft .NET Framework 4 is installed, or skipped if already present, Click "install" in the following window.



2.4 The "Ozone Adjustable dimmer" software will be automatically launched at the end of the installation procedure.



A new dedicated desktop icon and Start menu folder will be created for direct SW execution.

3 USB driver and Ozone Programming Tool installation procedure

3.1 Enter the "usb driver" folder (included in the "Ozone Setup Files.zip") and launch "OzoneDriverSetup" file.

3.2 If you have User Account Control enabled (Windows Vista or Windows 7), click "Yes" or "Continue" in the window that will appear on the screen.

3.3 Wait until the installation procedure ends.

3.4 Connect the Ozone Programming Tool to the USB PC port and follow all the instructions to complete the driver setup.

4 Software update

4.1 Uninstall the old SW version.

Go to: Start→Control Panel→Programs and Features→Ozone Adjustable Dimmer→Click "Uninstall/Change" button.

4.2 Install the new SW version, following the procedure from paragraph 2.

5 OZONE Adjustable dimmer SW setting

The "Ozone Adjustable dimmer" PC software has been designed to work in combination with the "Ozone programming tool" (see [AN3_Ozone Setting](#)). A custom night light profile shape can be created using the computer SW. After that, by a USB connection, it will be stored in the Ozone programming tool to program the Ozone LED driver memory without using a PC, directly in the final product field.

Once the custom night light profile shape is stored in the Ozone programming tool, it can be reloaded by using the PC SW or saved in a dedicate computer folder.

The procedure below will allow you an easy and fast product usage.

5.1 Start the PC SW clicking on the desktop icon or go to:

Start → Programs → Roal Electronics Spa → Ozone tools → Ozone Adjustable Dimmer.

The following Main Sw window will appear:

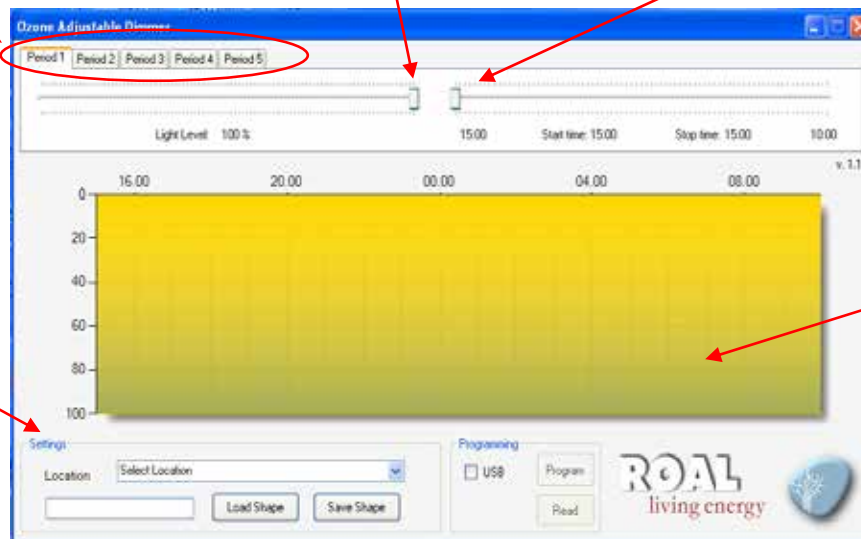
Up to 5 programmable independent light-level periods

Light level dimming slider

Period duration setting slider

Settings section

Light dimming profile window



5.2 Creating a new custom night light profile

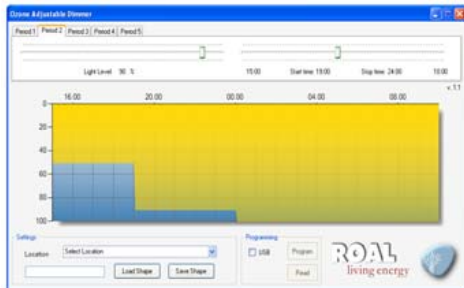
Starting from "Period 1" up to "Period 5", adjust all light levels and period durations by using the two dedicated sliders (see the example below).



Period 1:

Light level=50%

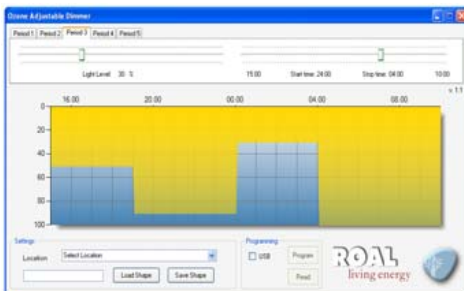
Duration= Start time 15:00 – Stop time 19:00



Period 2:

Light level=90%

Duration= Start time 19:00 – Stop time 24:00



Period 3:

Light level=30%

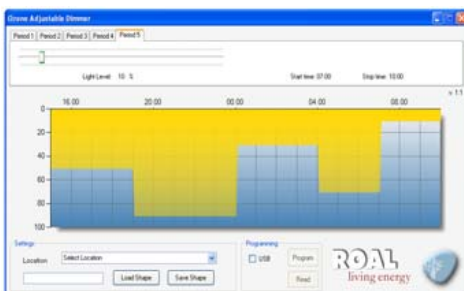
Duration= Start time 24:00 – Stop time 04:00



Period 4:

Light level=70%

Duration= Start time 04:00 – Stop time 07:00

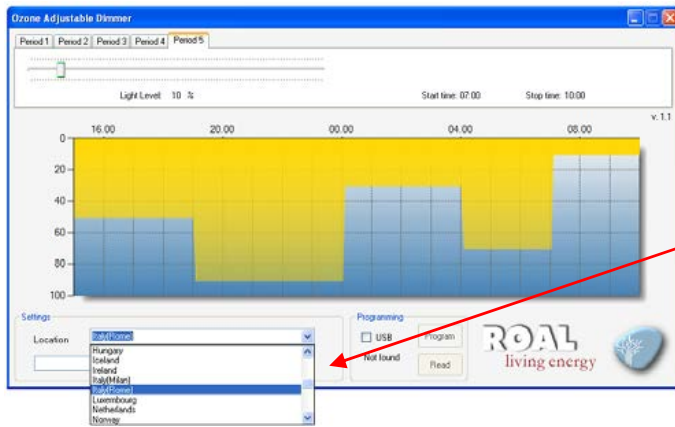


Period 5:

Light level=10%

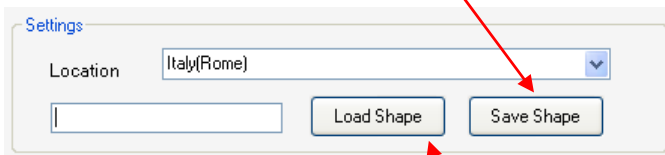
Duration= Start time 07:00 – Stop time 10:00

5.3 Geographic location selection and file saving



Open the Location dropdown menu in the Settings section and select the geographic installation area.

Now it is possible to save (as .load files) the custom light profile shape in a computer folder by clicking the "Save Shape" button.



It is possible to load .load files from the computer folder at any time by simply clicking the "Load Shape" button.

NOTES: The "Ozone Adjustable Dimmer" PC Sw permits to program a maximum 19 hours light profile shape. If the lamp remains powered for a time longer than 19 hours, during the additional hours (over 19 hours) the light level will remain at the "Period 5" level.

The custom light profile will be synchronized with the local (installation place) time after two (2) nights cycles.

Night durations below three (3) hours, will not be considered for the local time calculation.

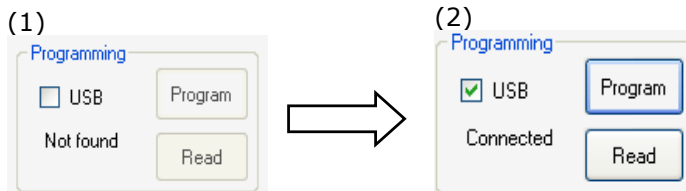
5.4 Programming sequence

Once the custom lighting profile shape has been defined, it can be transferred into the "Ozone Programming Tool" in order to be loaded in the OZONE LED Driver memory.

- Create your custom lighting profile shape or load an existing .load file.
- Connect the Ozone Programming Tool to the PC by a USB cable.



- Tick the USB connection in the Programming SW section (1) to establish the communication between the PC and OPT. The word "connected" will appear in the Programming section (2).



If the device is not connected to the PC USB port or if a problem was encountered during the connection, an error message will appear.

- Click the "Program" button (2) to transfer the lighting profile shape into the Ozone Programming Tool.
A success feedback message will appear.



For a double check click the "Read" button (2) to display the light profile shape loaded in the Ozone Programming tool.

- Disconnect the OPT from the computer USB port and follow the AN3_Ozone Setting instruction to install your custom light profile shape in the Ozone LED driver.

OZONE RSOZ070 SERIES

*70W Single Channel
Programmable LED Drivers*

ELECTRICAL FEATURES

- Universal Input Range (120/240/277 Vac)
- High Efficiency, 90% typ
- Active PFC > 0.9
- THD < 20%
- 3,75W +5Vdc Auxiliary Output
- OV, OC, OT and Short Circuit Protection
- -30°C / +85°C Operating Case Temperature
- Low Output Ripple Current
- Intelligent Cold Start Function and Undervoltage dimming Function
- Long Life Time
- ROHS Compliant

CONTROL FEATURES

- Programmable Constant Current Output
- Easy to use Program Interfaces (Ozone Programming Tool and Ozone Toolset Software)
- 0-10V or 1-10V Standard Dimming Controls
- LEDs Over Temperature Protection (by NTC)
- DALI Ready (IEC 62386)
- PWM Ready
- Adjustable Dimmer Function
- Constant Light Function
- Fade Time Setting

SAFETY APPROVALS:

World Wide Safety Approvals



DESCRIPTION

Ozone is a 70W programmable LED Driver that combines smart technology and high flexibility features.

A single channel, constant current LED ballast, Ozone is designed for directly powering up LEDs in high power indoor and outdoor lighting fixtures, such as street and tunnel lighting, parking lot and wide area lighting, as well as in industrial and high bay lighting applications.

Designed in a super compact 5.82"x2.36"x1.37" package, the Series includes only four different models that cover applications from 20V to 195V, with currents from 350mA to 2.6A.

The intelligent core of the driver permits to program the output current in 50mA steps inside the range of each model, which makes the Ozone extremely flexible and suitable for different kind of applications.

By converting energy at 90% typical efficiency, the Ozone Series makes easier the thermal management in space constrained systems, offering high reliability in environmentally friend solutions.

A built in +5V Auxiliary circuit permits to power up active cooling devices or external logic, while the DALI/PWM interface makes the driver configurable through the standard control protocols.

With the optional *Ozone Programming Tool* and the free *Ozone Toolset Software* users can implement advanced functions, such as the Adjustable Dimming and the Constant Light ones, which eliminate the need for any additional electronics inside the fixture except the LEDs themselves.

Models Table

Ozone 70W LED Drivers Series is composed of four models, with the following output current and voltage rates.

Model Number (Ordering Code)		Pout max	Output Voltage Range (Under Regulation)	Absolute Maximum Vout (Under any condition)	Iout min ; Iout Max
Package	Dash #	W	Vdc	Vdc	mA
RSOZ070	-200-Full	70	From 120 to 195	200	From 350 to 550
RSOZ070	-120-Full	70	From 60 to 115	120	From 350 to 1100
RSOZ070	-60-Full	70	From 30 to 56	60	From 350 to 2100
RSOZ070	-35-Full	70	From 20 to 33	35	From 1000 to 2600

The output currents and the control features can be set for each model through the *Ozone Programming Tool* and *Ozone Toolset Software*.

Refer to the appropriate Application Notes and User Manuals for further details on the programmability features.

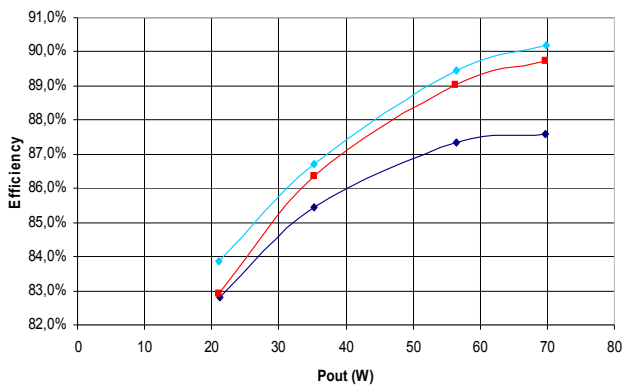


Efficiency and PFC performance

Ozone LED Driver shows very good efficiency and power factor performance even when operating at low loads. For each model the typical efficiency value is 90%, while the PF is >0.9 from 30% max load at 120Vac, 50% max load at 230Vac, 80% max load at 277Vac.

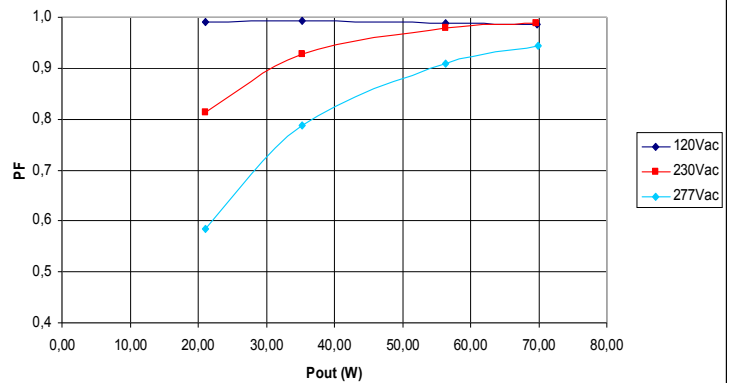
Following are the characteristic plots for the four Ozone LED driver models, referring to the maximum output voltage operating condition.

Efficiency / Pout (Max Output Voltage)

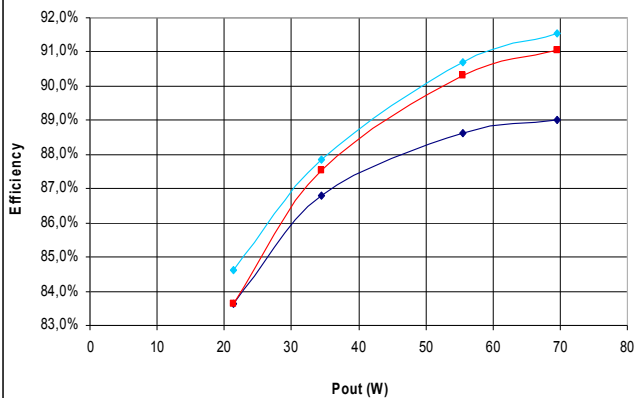


RSOZ070-35-Full

PF / Pout (Max Output Voltage)

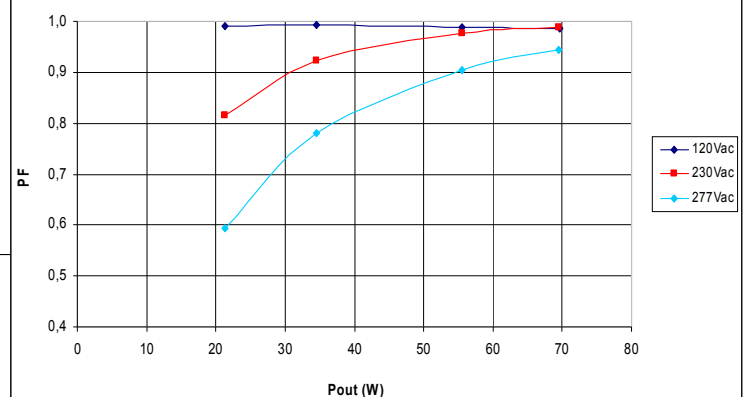


Efficiency / Pout (Max Output Voltage)

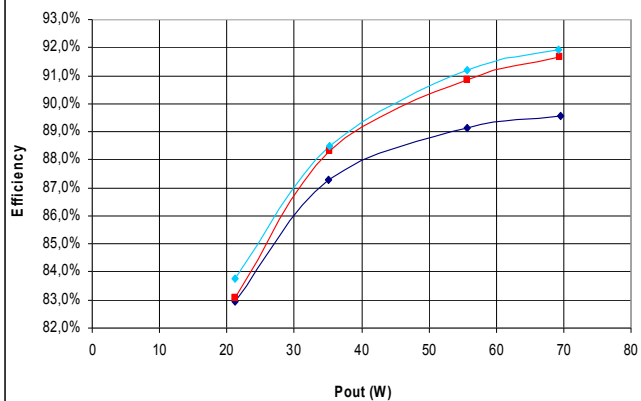


RSOZ070-60-Full

PF / Pout (Max Output Voltage)

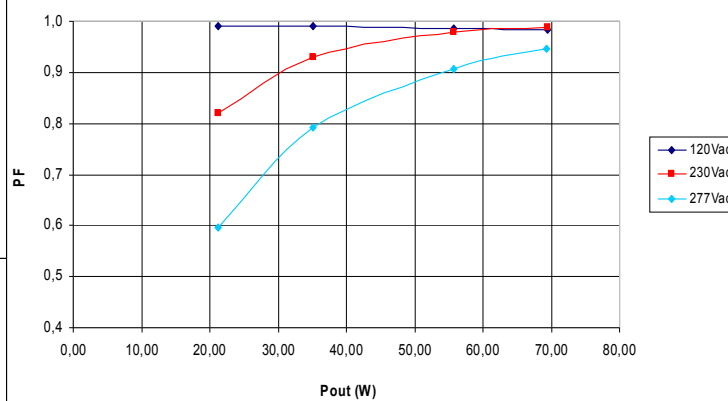


Efficiency / Pout (Max Output Voltage)

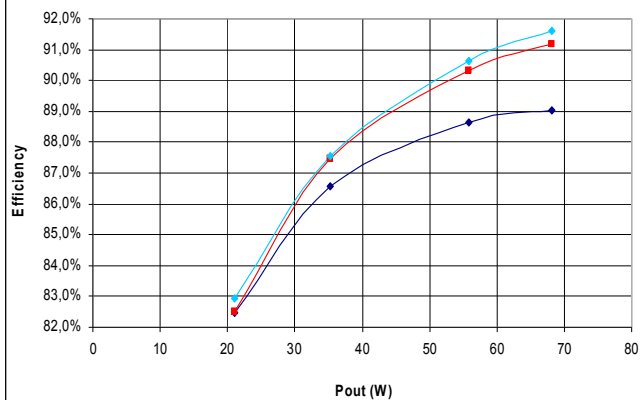


RSOZ070-120-Full

PF / Pout (Max Output Voltage)

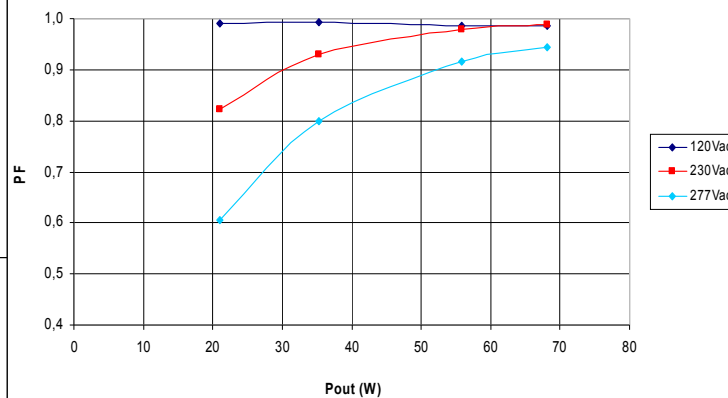


Efficiency / Pout (Max Output Voltage)



RSOZ070-200-Full

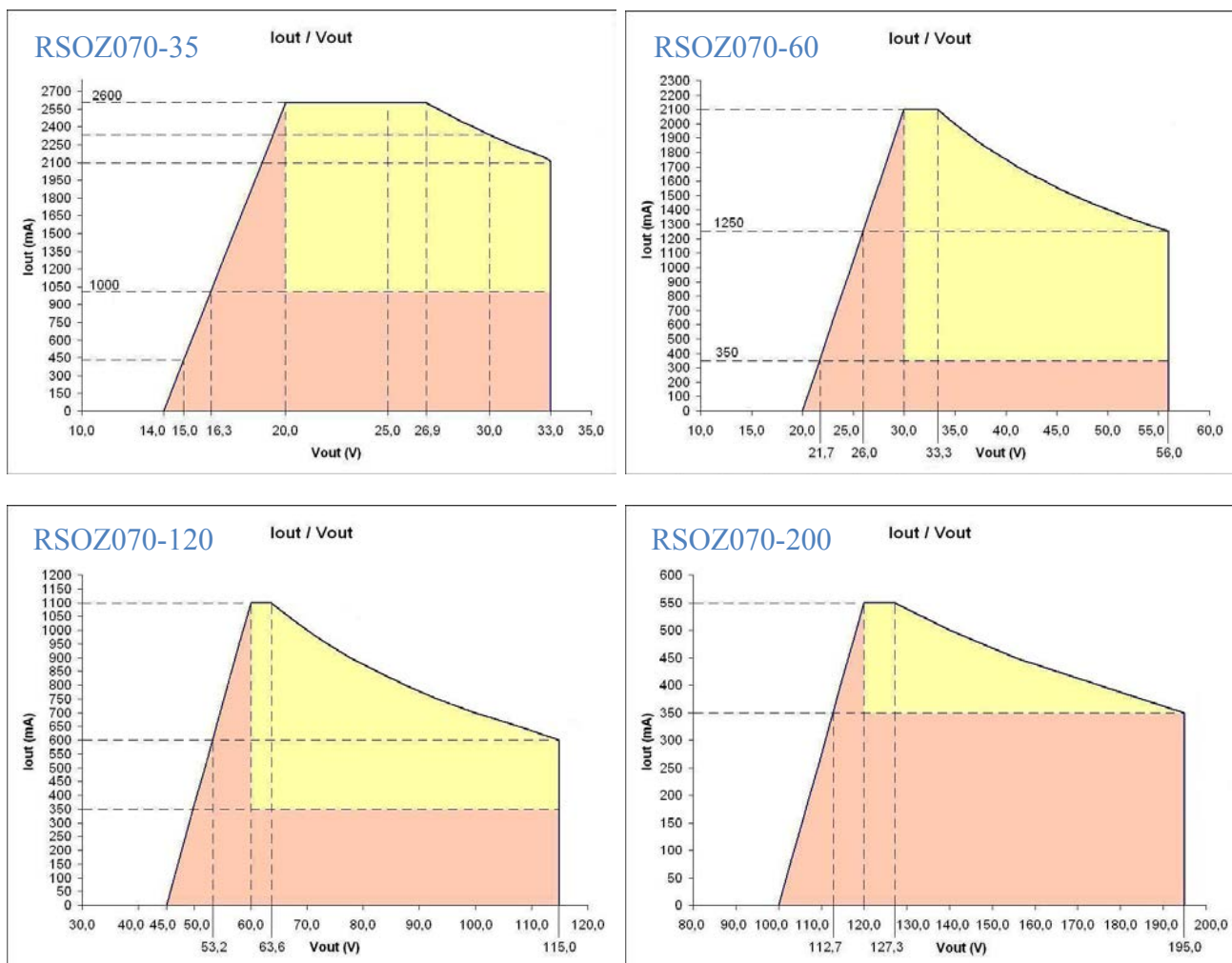
PF / Pout (Max Output Voltage)



Undervoltage Dimming Operation

Ozone LED driver is able to operate under the minimum value of the output voltage range in order to allow dimming functions through an analog signal (0-10V, 1-10V or variable resistor) or a DALI/PWM signal. It is therefore possible to reduce the output current starting from a full load condition located near the bottom value of the output voltage spec ($V_{out\ min}$).

The dimming profile is different for each Ozone model and it's reported in the following plots, where the yellow area represents all the possible programmable working points, while the pink area is reached only under dimming conditions.



The undervoltage areas, below the minimum output voltage value, can be reached only under dimming operations; if the driver enters the undervoltage region when operating at nominal current it will automatically shut down (a 2V margin is allowed under the minimum voltage range value).

The final application should be designed in order to operate always within these characteristics.

Intelligent Cold Start Function

In order to fully cover all the available output voltage range, Ozone LED driver introduces an intelligent control of the LED load voltage at start up.

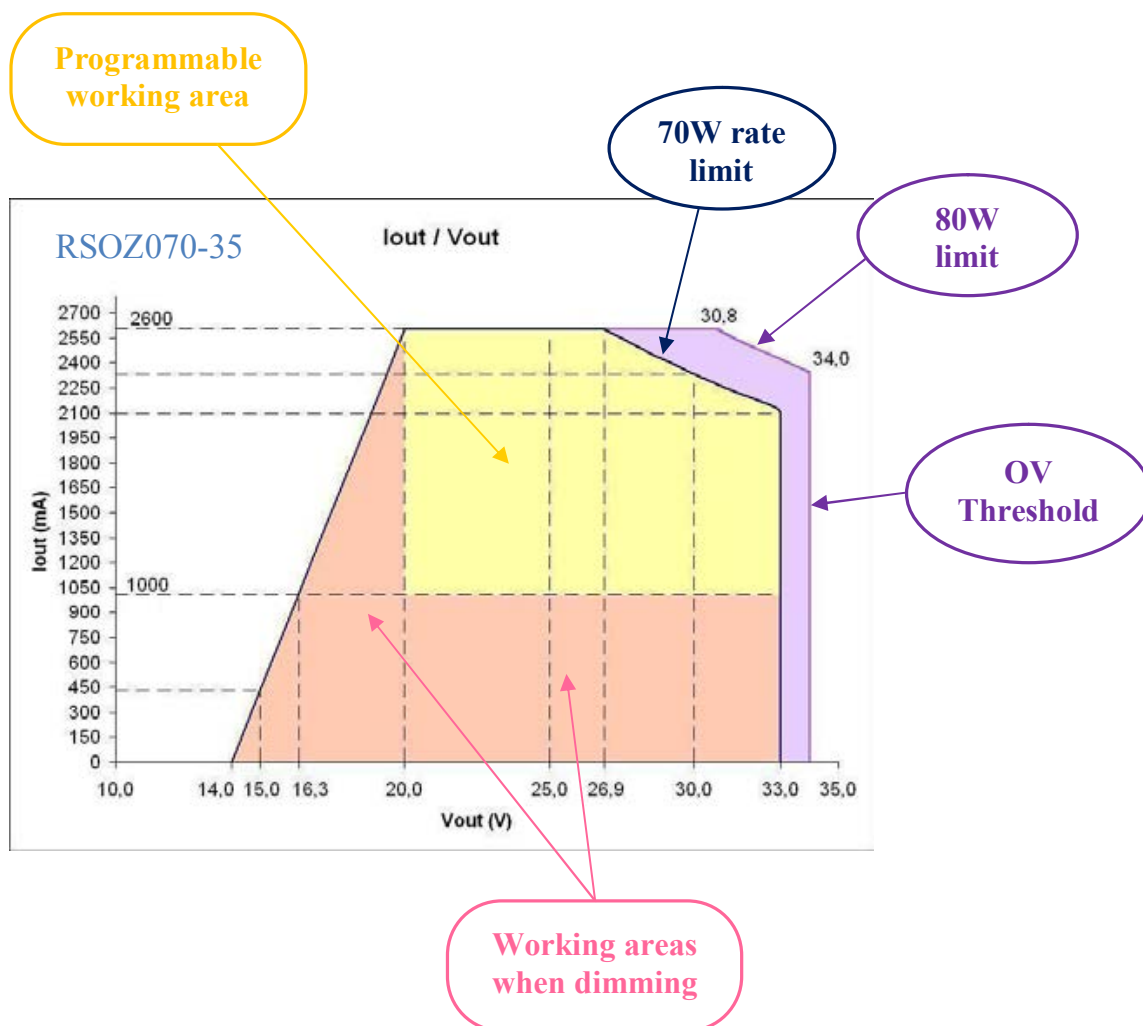
For each settable current, the driver temporary accepts and controls an overload voltage higher than the maximum specified one (while the LEDs are cold), permitting therefore to operate very close to the upper limit of the range even when the LEDs heat up.

When the output power is higher than 72W and lower than 80W, the driver automatically reduces the output current in order to limit the load power under 72W. As the LED string heats up lowering the overall forward voltage, the driver gradually increases the current toward the nominal set value.

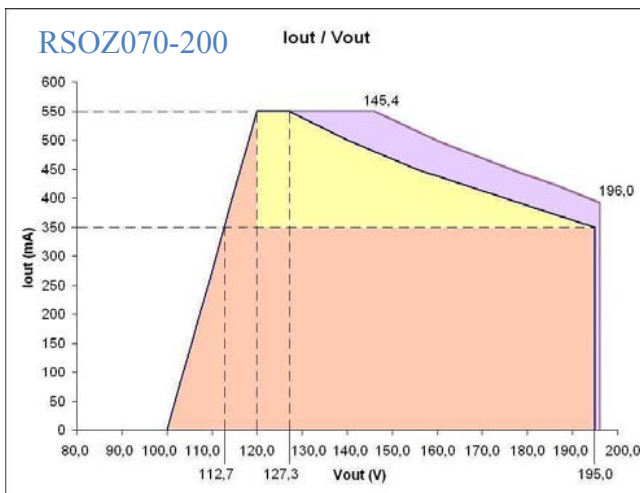
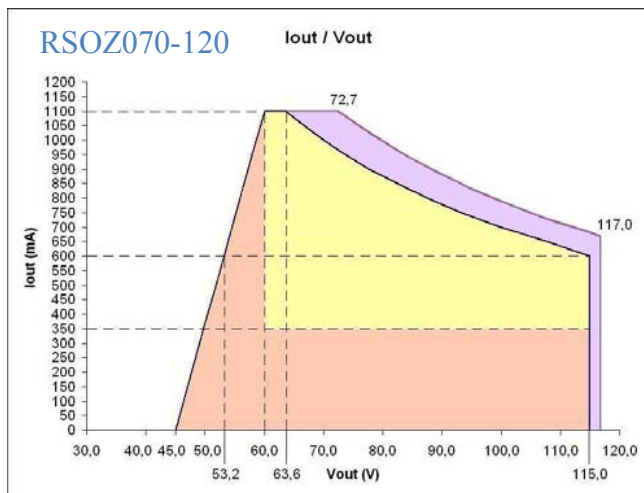
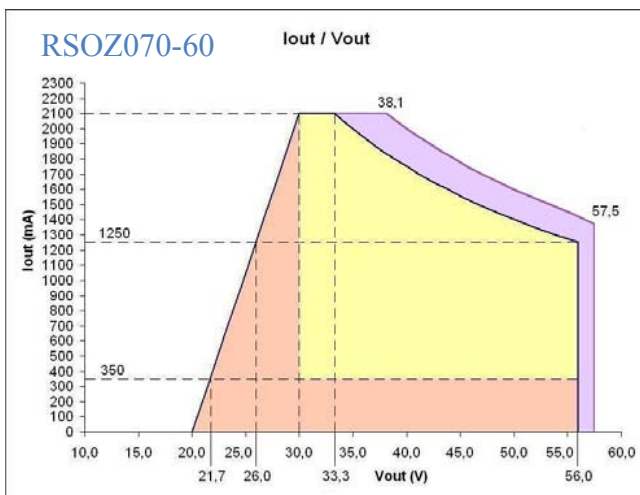
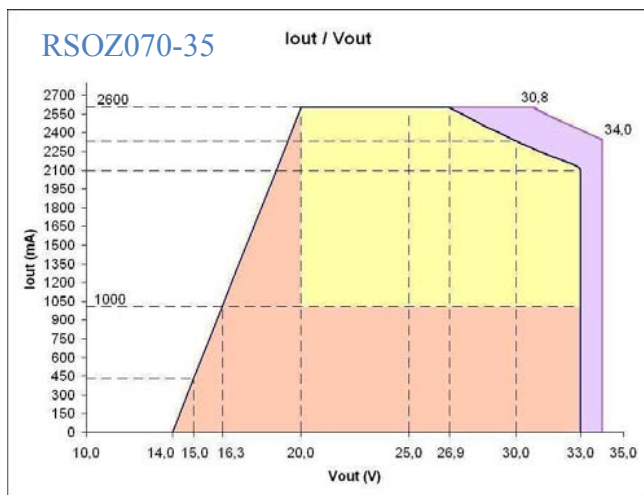
If an overload higher than 80W is detected, the driver shuts down until it is powered off and on again.

Each Ozone model has nevertheless an absolute voltage threshold (OV Threshold) that cannot be violated under any operative condition; if the load exceeds this limit the driver enters the over voltage protection mode and shuts down.

Referring to Ozone *RSOZ070-35-Full*, the following plot explains the Intelligent Cold Start Function and the different working regions. The purple area represents the temporary admitted overload working points.



The characteristic plots for the four Ozone 70W models are reported here below.



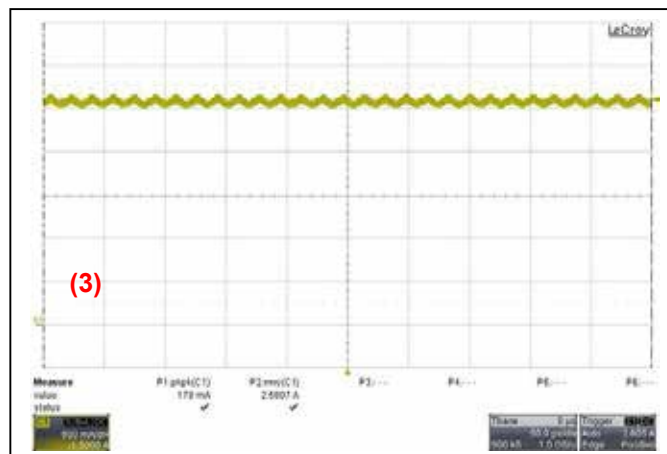
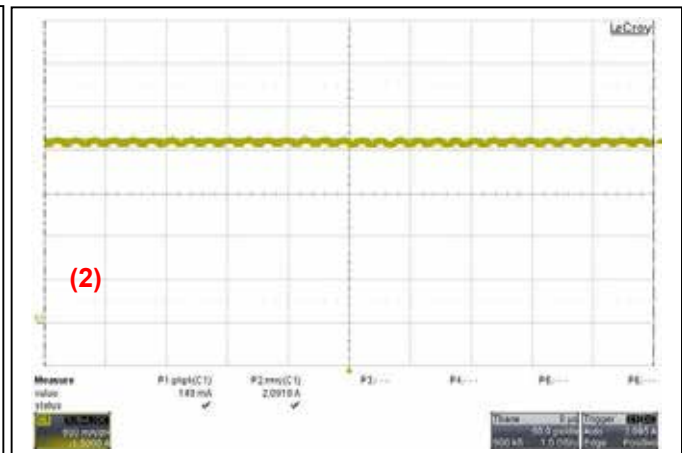
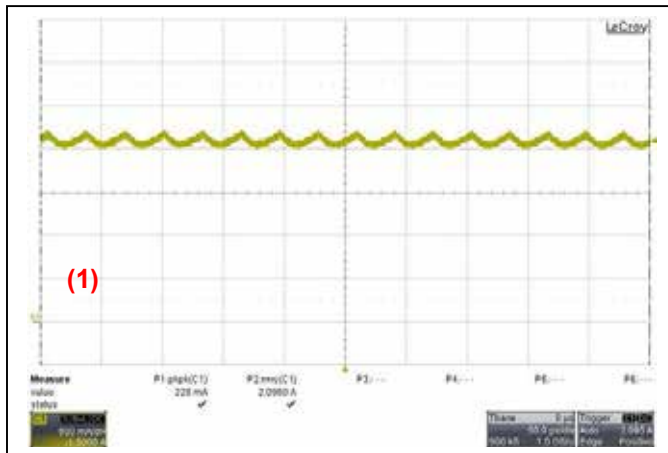
Output Ripple Current Characteristics

The driver's digital control of the output current permits to maintain a very low ripple current value on the LED string for all over the different voltage/current working points. The ripple current value is usually higher when operating at full power towards the upper limit of the output voltage range, while it decreases significantly (under 10% of the set current) for working voltages located near the bottom value of the range.

Following are reported the ripple current measurements and plots for each Ozone model.

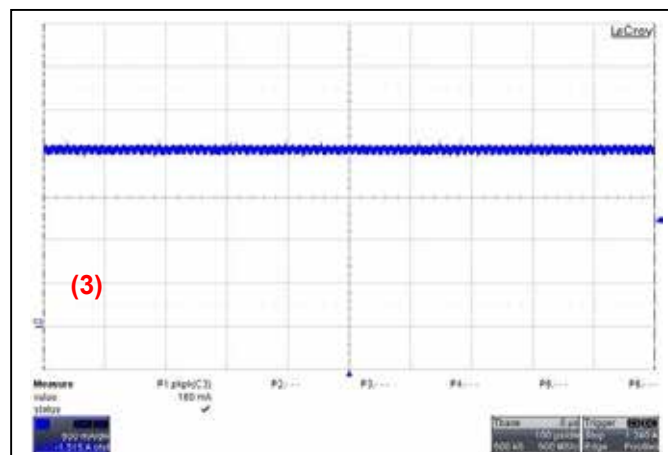
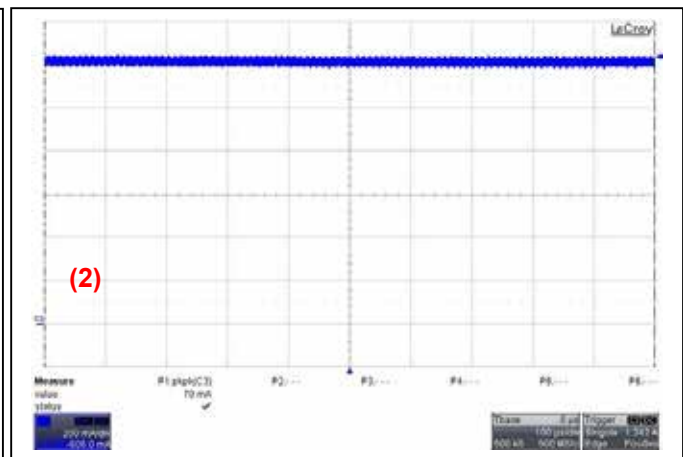
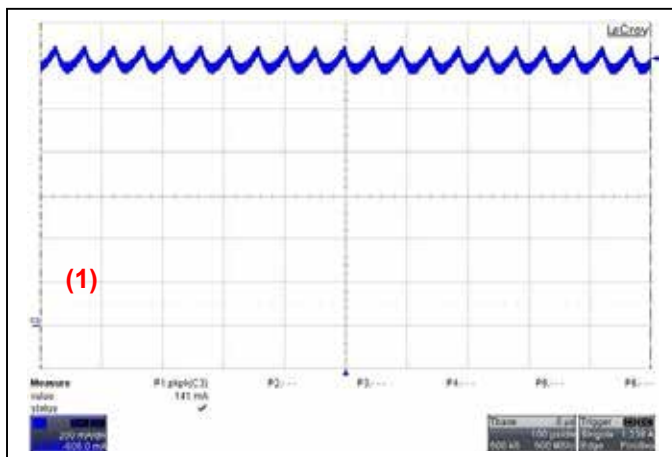
RSOZ070-35-Full			
Load Voltage (V)	Load Current (mArms)	Ripple Current (mA pk-pk)	Ripple Current %
32.86	2096	228	10,9% = $\pm 5,45\%$ (1)
28.54	2093	163	7,8% = $\pm 3,90\%$
20.20	2092	149	7,1% = $\pm 3,55\%$ (2)

26.77	2581	178	6,9% = $\pm 3,45\%$ (3)
20.14	2583	165	6,4% = $\pm 3,20\%$



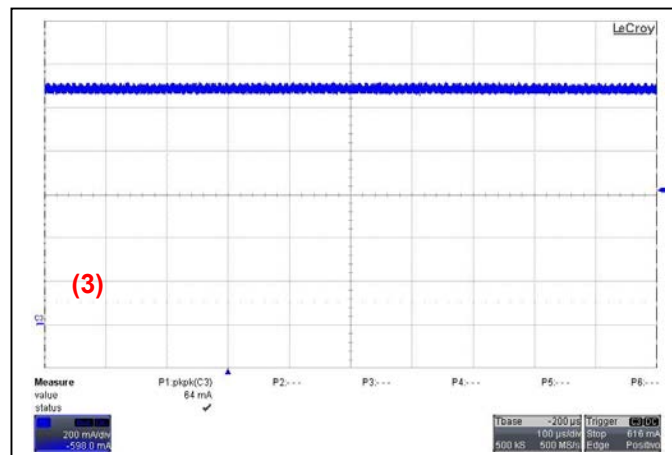
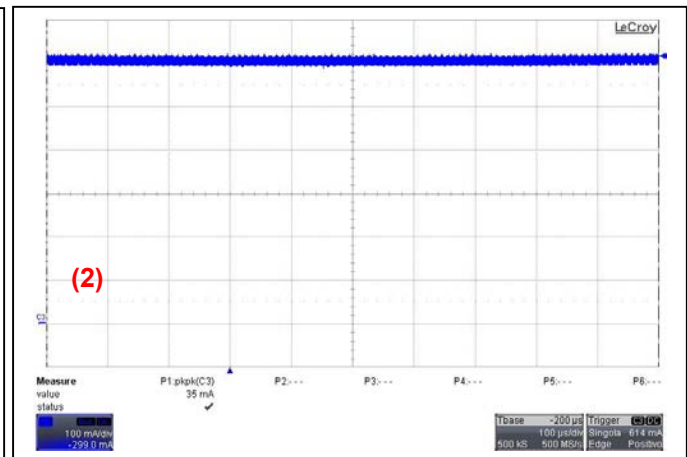
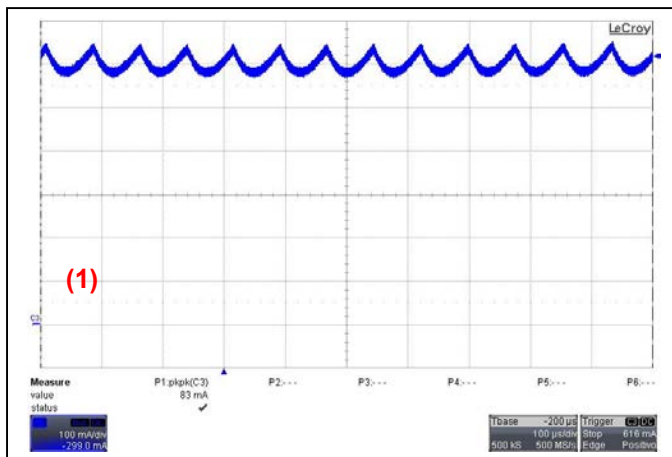
RSOZ070-60-Full

Load Voltage (V)	Load Current (mAmps)	Ripple Current (mA pk-pk)	Ripple Current %
56,0	1247	141	11,3% = $\pm 5,65\%$ (1)
54,9	1246	122	9,8% = $\pm 4,9\%$
52,8	1247	102	8,2% = $\pm 4,1\%$
49,8	1249	83	6,6% = $\pm 3,3\%$
44,6	1248	77	6,2% = $\pm 3,1\%$
40,3	1247	77	6,2% = $\pm 3,1\%$
37,3	1247	70	5,6% = $\pm 2,8\%$
33,9	1245	70	5,6% = $\pm 2,8\%$
30,6	1244	70	5,6% = $\pm 2,8\%$ (2)
33,3	2104	160	7,6% = $\pm 3,8\%$ (3)
30,2	2097	144	6,9% = $\pm 3,45\%$

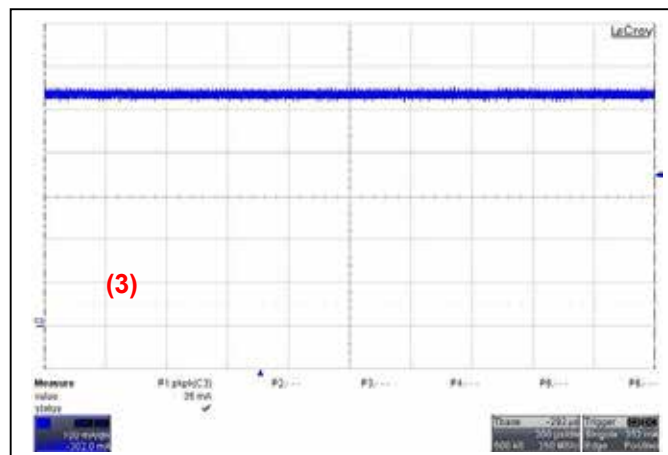
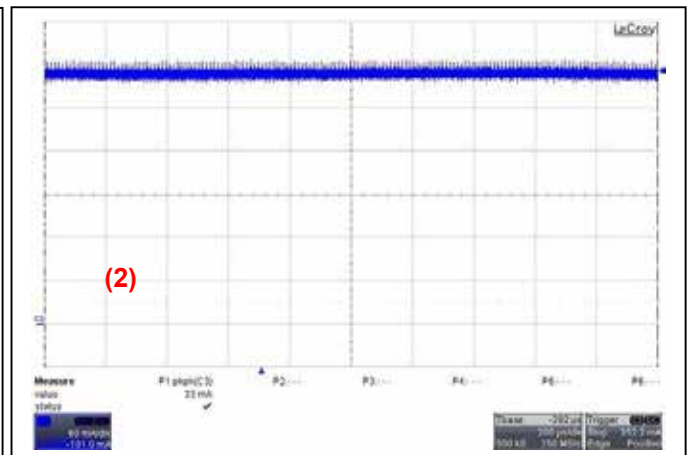
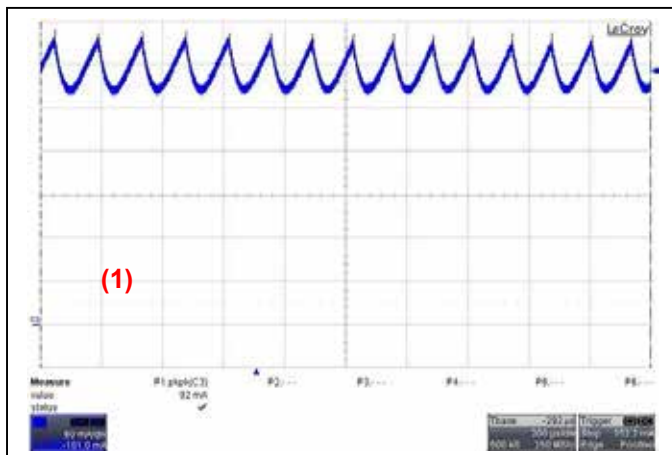


RSOZ070-120-Full

Load Voltage (V)	Load Current (mArms)	Ripple Current (mA pk-pk)	Ripple Current %
114.8	603	83	13,8% = $\pm 6,90\%$ (1)
111.5	604	58	9,6% = $\pm 4,80\%$
108.3	606	48	7,9% = $\pm 3,95\%$
101.6	606	45	7,4% = $\pm 3,70\%$
91.7	607	42	6,9% = $\pm 3,45\%$
80.1	608	38	6,2% = $\pm 3,10\%$
72.8	608	35	5,7% = $\pm 2,85\%$
64.4	610	35	5,7% = $\pm 2,85\%$
60.0	610	35	5,7% = $\pm 2,85\%$ (2)
63.6	1091	64	5,9% = $\pm 2,95\%$ (3)
59.9	1094	64	5,9% = $\pm 2,95\%$



RSOZ070-200-Full			
Load Voltage (V)	Load Current (mArms)	Ripple Current (mA pk-pk)	Ripple Current %
194.9	352	92	26,1% = $\pm 13,05\%$ (1)
191.5	346	60	17,3% = $\pm 8,65\%$
182.1	345	42	12,2% = $\pm 6,10\%$
169.8	344	38	11,0% = $\pm 5,50\%$
148.5	346	36	10,4% = $\pm 5,20\%$
134.0	346	36	10,4% = $\pm 5,20\%$
124.6	348	35	10,0% = $\pm 5,00\%$
120.1	349	33	9,5% = $\pm 4,75\%$ (2)
127.2	542	35	6,5% = $\pm 3,25\%$ (3)
119.9	537	32	6,0% = $\pm 3,00\%$



Inrush Current Data

Due to its very limited Inrush Current peak at power on, Ozone LED driver makes easier the selection of overcurrent protection devices such as circuit breakers.

Referring to the different kinds of Circuit Breakers available on the market, the maximum number of connectable Ozone drivers is reported in the following table for each nominal input voltage.

Vin nominal	Inrush Current Data		Maximum Loading for each Circuit Breaker Series (number of drivers)					
	I peak (A)	Half Value Time (μs)	Type B 10A	Type B 16A	Type C 10A	Type C 16A	Type D 10A	Type D 16A
120Vac	11	250	25	40	41	66	83	133
230Vac	21	246	13	20	21	34	43	69
277Vac	26,8	250	10	16	16	27	33	54

DALI Stand-by power consumption

Ozone LED driver offers a very low stand-by power consumption when the LEDs are switched off from the DALI port (DALI off command) and the auxiliary output is not loaded.

The typical stand-by power consumption is reported in the following table for each nominal input voltage.

Vin nominal	DALI Stand-by typ. consumption (mW)
120Vac	279
230Vac	408
277Vac	502

Introduction

Ozone LED Driver is an Intelligent and flexible device, designed for indoor and outdoor lighting applications.

This Application Note “[AN1 Ozone Wiring Diagram](#)” provides technical information for the wiring connections of the Ozone LED Driver and mechanical fixing (all models).

Ozone LED Driver has a wide voltage range input connector and a multifunction output connector for LED connections, LED thermal protection (NTC), dimming and +5Vaux. It has also an additional connector for DALI communication.

This document describes how to connect the Ozone LED Driver (AC Input, Constant Current output Channel, Communication and Controls).

Connectors Overview



Figure 1: Input AC connector



Figure 2: LEDs, NTC, 0-10V / 1-10V Dimming, Vaux and DALI connectors

AC Input Connection

Ozone LED Driver can be powered by a wide voltage range AC Input from 120 to 277Vac (**Figure 4**).

Consult the product DataSheet "[DS1_Ozone LED Driver 70W](#)" for Input Voltages and Current ratings.

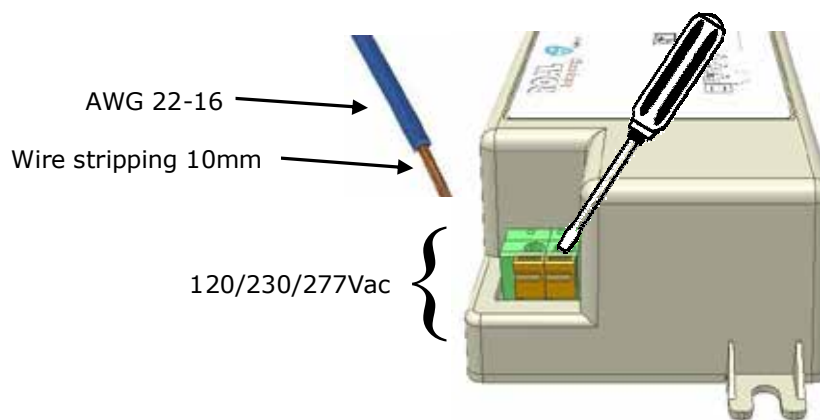


Figure 4: AC input Connector



CAUTION: Electrical shock risks.

Wrong device installation can cause serious injuries to the user, and irreparable damages to the device and to the connected LED lamp.

The driver may be installed only by qualified operators.

Output and Driving Connection

Ozone LED Driver versatility permits the user to approach different driving solutions as showed below (see **Figure 5**). Consult the DataSheet "[DS1_Ozone LED Driver 70W](#)" for Output Voltages and Current ratings.

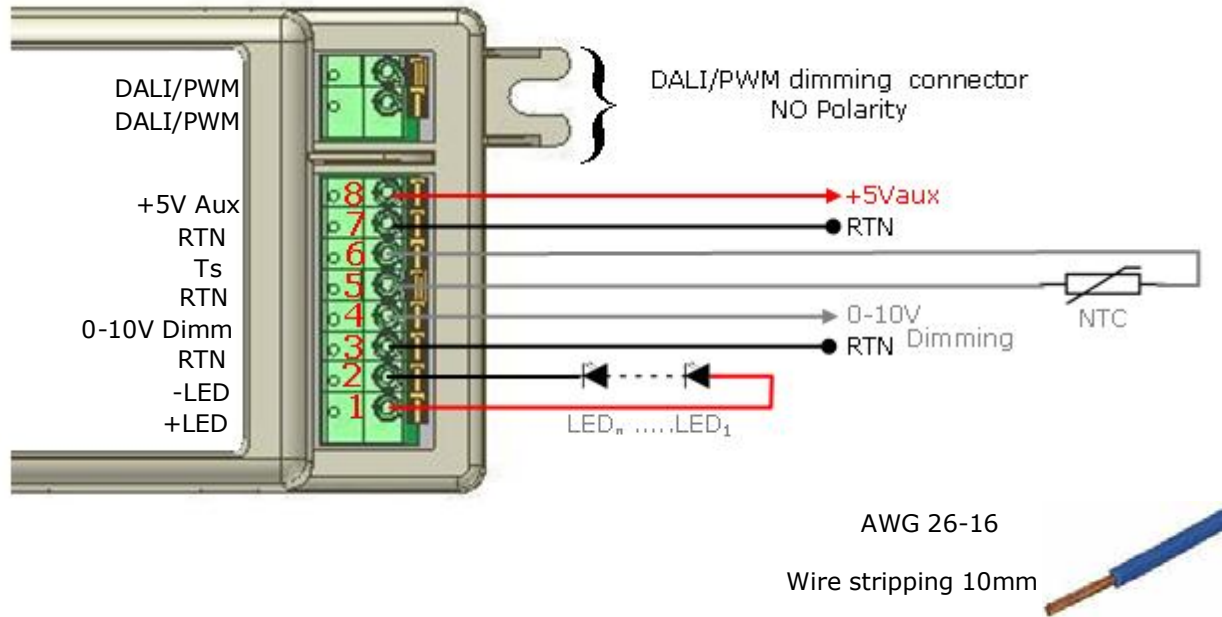


Figure 5: Ozone Output and Control Connections

Connector	Pin number	Pin name	Description
8 pins connector	1	+LED	LEDs positive output
	2	-LED	LEDs negative output
	3	RTN	Return
	4	0-10V DIMM	1/10V dimming input
	5	RTN	Return
	6	Ts	Thermal sense input
	7	RTN	Return
	8	+5Vaux	Auxiliary +5V
2 pins connector	1	DALI/PWM	DALI input or PWM dimming input
	2	DALI/PWM	DALI input or PWM dimming input

Table 1: Ozone Connections Table

Output/Control	Short Description
+LED, -LED	Use these connector pins (1-2) to connect the LED string. Pay attention to respect the LED Driver output ratings. For additional info see the Product DataSheet " DS1_Ozone LED Driver 70W ".
0-10V Dimm	An external 0-10V standard dimmer can be connected to dim the LED driver output current, from 10% to 100% of the maximum current set . For additional info see " AN2_Ozone Temperature Sense& 0-10V dimming ".
Ts (Thermal sense)	Using output connector pins (5-6), to connect a negative coefficient thermistor (NTC), in order to avoid a potential extra temperature of the LED fixture. For additional info see " AN2_Ozone Temperature Sense& 0-10V dimming ".
+5V Aux	Using output connector pins (7-8), the user has the possibility to power an external active cooling device or any max 3.75W external control circuitry.
DALI	Ozone LED driver can be connected to a DALI network using the dedicated 2-way connector, both for input and output transmissions without polarity. The same connector may be used for PWM dimming. For additional information see " AN4_Ozone DALI&PWM Dimming " .
PWM dimming	Ozone can accept a PWM dimming signal on the DALI input connector according to the EN60929 annex E3. For additional info see " AN4_Ozone DALI&PWM Dimming ".

Table 2: Ozone Output and Controls

Mechanical Fixing

Ozone LED Driver has to be mounted on a flat surface as shown in Figure 6.

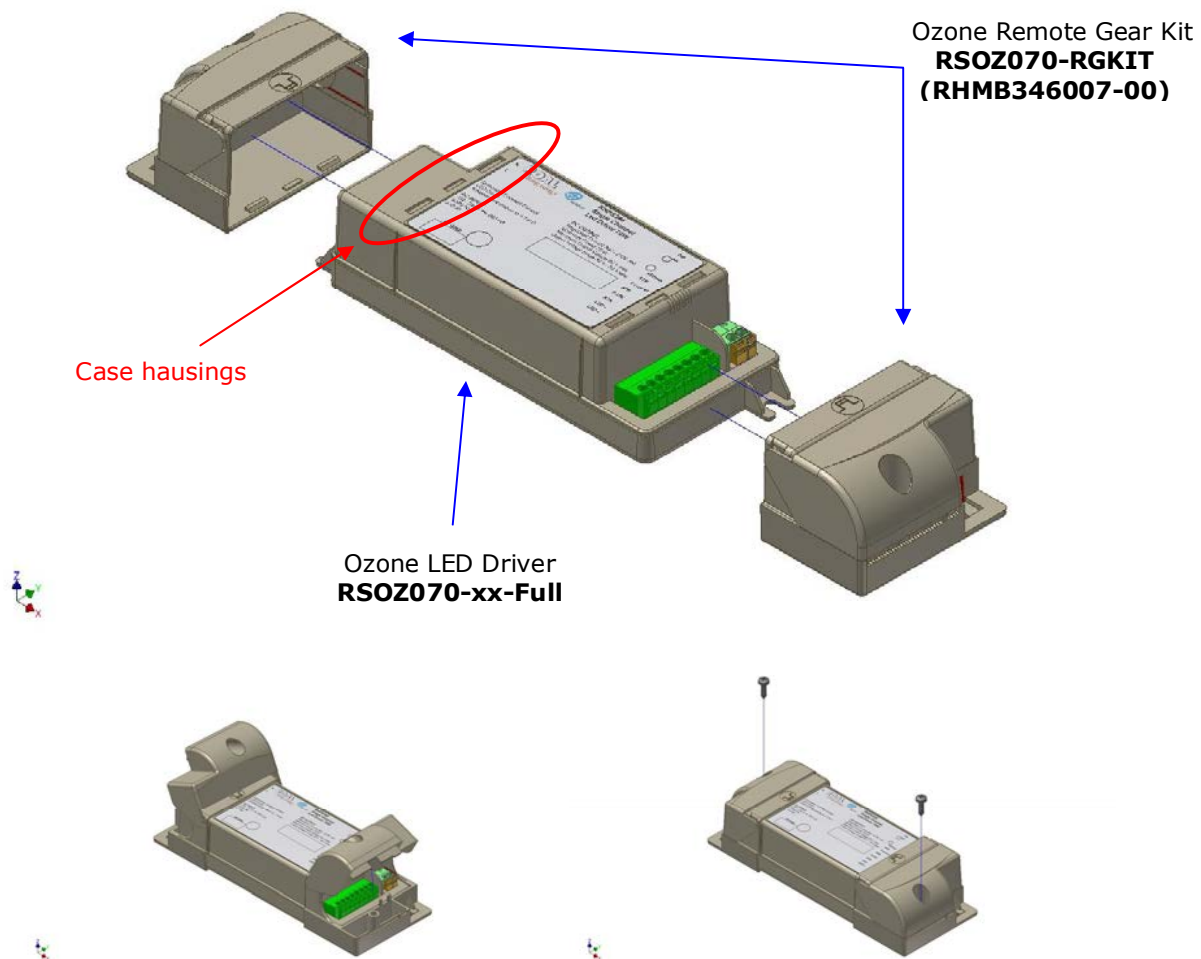


Figure 6: LED Driver mounting

Ozone Remote Gear Kit

Ozone LED driver can be installed as an Independent Unit by using the Ozone Remote Gear Kit, available as optional with the code **RSOZ070-RGKIT** (Roal production code: RHMB346007-00).

The kit is easily assembled by pushing the two shells toward the input and output connectors, locking them in the case housings and securing the unit by tightening the two screws in place, as shown in the following pictures:



Suggested AWG wires and screws for a good mechanical installation are the following:

<i>Input and Output connectors:</i>	wires AWG 18/20 Style 1007
<i>Dali connector:</i>	wires AWG 22/24 UL1672
<i>Screw type:</i>	Thread forming screw for thermoplastic, Pan head screw, Phillips H cross recessed, d:3.5mm L:12mm
<i>Screw torque:</i>	10-12Kgf x cm, Phillips H2 screwdriver tip

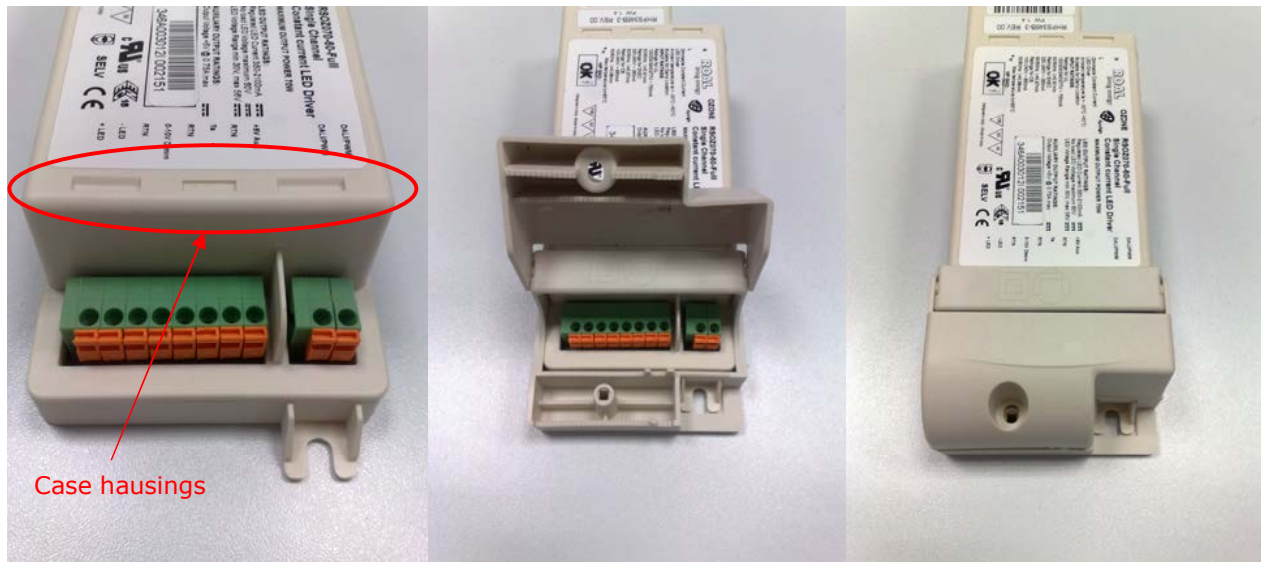


Figure 7: Ozone Remote Gear Kit installation

The Independent Unit mark  is indicated on the kit, as illustrated in Figure 8.



Figure 8: Ozone Remote Gear Kit

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Introduction

Ozone LED Driver is a digital and intelligent Single Channel LED Driver designed for White LED Applications.

This Application Note "[AN2_Ozone Temperature Sense & 01-10V Dimming](#)" provides technical information to realize an efficient and cost effective Over Temperature Protection of the LEDs driven by Ozone, and to dim linearly the output current with a 0-10V or 1-10V external dimming signal. If you are interested in the PWM Dimming in that case please refer to the Application Note 4 "[AN4_Ozone DALI & PWM Dimming](#)".

Ozone includes a dedicated input (Ts) to realize LEDs Over Temperature protection. Basically it consists in adopting a Negative Temperature Coefficient sensor (NTC) to detect the PCB Temperature near the LED solder joint, reducing the output current when a critical high temperature is reached.

The Thermal protection described in this Application Note is simple and fast to implement; nevertheless if this protection is not possible or not necessary to be adopted, consider that the Ozone Thermal sense input pin (Ts) can be leaved unconnected; therefore if no connection is made, the Driver operates at the nominal output current set point and the LED's temperature does not influence the output current value.

This document contains also all the information necessary to dim LEDs by using a 0-10V or 1-10V signal that comes from a standard dimmer or external control circuitry or sensors.

Ozone dimming characteristics have been tailored to meet the requirements of IEC 60929 Annex E.

Thermistor Connecting

This section shows different type of Thermistors and explains how to connect a Negative Temperature Coefficient (NTC) Thermistor to Ozone.

A single Channel LED Driver is typically used to power White LEDs, usually all connected in series.

The final application can be a LED Lamp dedicated to Indoor (Wide Area Lighting) or Outdoor Application (Urban and Street Lighting). Regardless the final use in many cases it is important to protect LEDs against an Over Temperature that might occur due to abnormal condition.

When using Ozone LED Driver, the use of an appropriate Thermistor (NTC) to monitor the PCB's temperature allows to realize an efficient and cost effective LED Board Over Temperature Protection; the thermistor connection is shown in Figure 1.

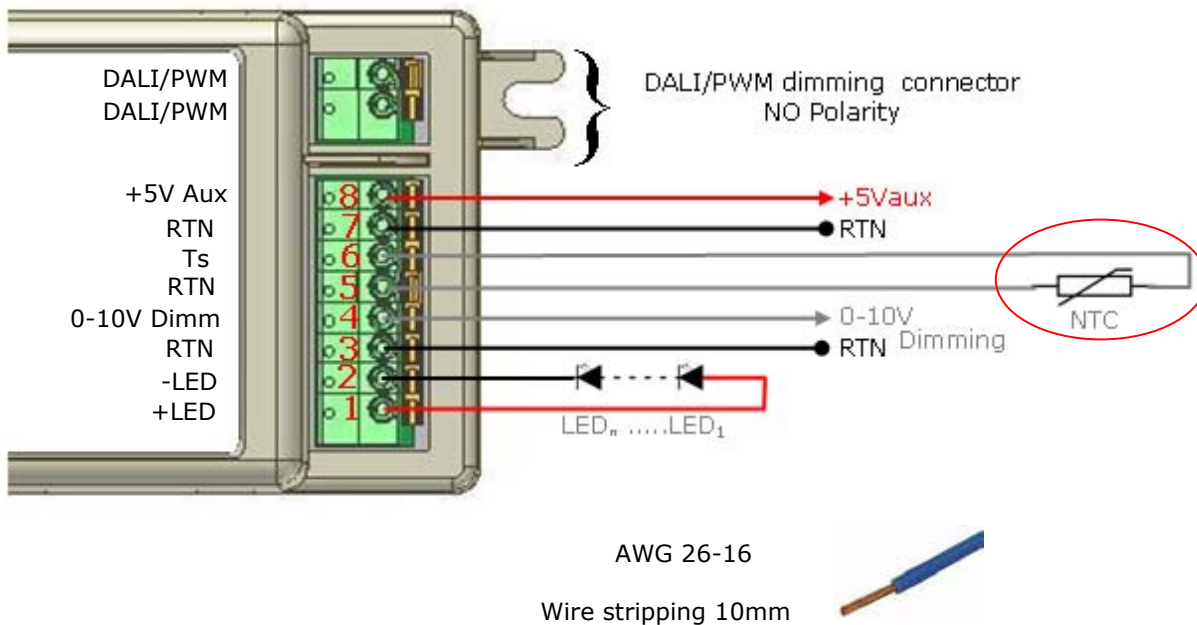


Figure 1: NTC Connection (output connector pins 5 and 6)

In some cases the monitoring of the temperature of the PCB or heatsink where LEDs are mounted is not possible or not required. In this case the dedicated Temperature Sense Input (Ts) can be left open (not connected) and the Temperature of the LED Board's PCB will not influence the Ozone output current.

SMD e non-SMD NTC Thermistors

There are many thermistors with various technologies/case size available in the market and produced by several manufacturers (Epcos, Vishay, Murata, AVX and others).

Thanks to Ozone design a Negative Temperature Coefficient (NTC) thermistor can be used to reduce the output current in case of LED Board Over Temperature Condition.

The most common NTCs used in LED Lighting are SMD devices (see Figure 2). This kind of NTC can be quickly mounted during the SMD assembling phase and it is available with different sizes (0805, 1206, 0603 and others).

Of course if LEDs are placed into the LED Board through the SMD process (e.g. LEDs produced by Lumileds, CREE, Osram, Seoul, Nichia etc.), then the right choice for the NTC is a SMD Thermal Sensor.



Figure 2: SMD NTC thermistor



Figure 3: Ring lug NTC thermistor

Nevertheless some LEDs (e.g. Multichip LEDs) produced by Manufactures like Bridgelux, Citizen, Xicato etc. , are designed to be mounted directly on the heatsink fixing them by the use of screws. In this case the SMD assembling phase is not present in the LED Board production process and a LUG NTC (see Figure 3) can be easily adopted because it is assembled as a probe, in order to be assembled on the LED's heatsink by using a screw.

For best performance, the NTC sensing thermistor should be located close to LEDs or in the hot spot of the LED Board, if any.

Current reduction versus the resistance value

When the temperature increases over a certain limit, the NTC mounted on the LED Board measures the Temperature of the mounting surface (PCB or heatsink) and the Temperature Sense feature allows to reduce the output current of the Driver. The following graph shows the relationship between the resistance connected to the Temperature Sense input and the corresponding output current reduction.

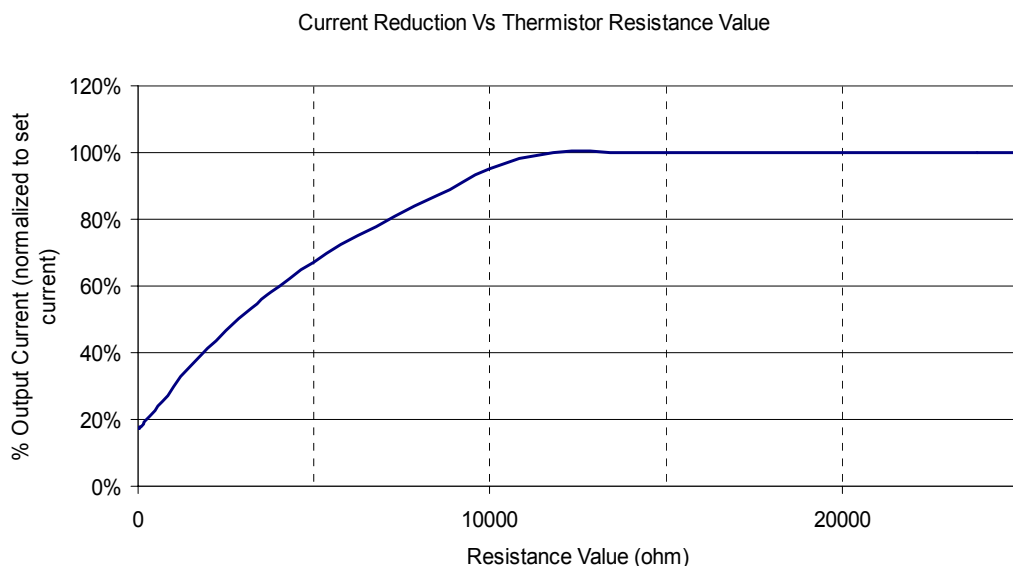


Figure 4: Output Current (%) along Thermistor (NTC) Resistance Value

At normal operating condition (where NTC's resistor is more than about 11 k Ω), the temperature sense input has no effect on the driver output current. This means that the Output Current is equal to the Current Set ($I_{out}=100\%I_{set}$). As the temperature rises determining a NTC resistor value below 10k Ω -10.5k Ω , the output current of the driver begins to drop resulting in a reduction in the temperature at the LEDs.

In this graphic the current reduction is exclusively due to the Over Temperature Condition and the effect of the Dimming is NOT considered (Dimming=100%), to avoid to mix the two different current reduction causes.

When the current is reduced due to LED Board Over Temperature condition, many factors, predominately the thermal impedance of the LED heatsink, play a role in determining the ultimate thermal equalization.

According to Figure 4, when the Over Temperature Condition is removed, the Output current comes back gradually to its original Value ($I_{out}=100\% I_{set}$).

NTC selection

Figure 4 shows that the Output Current reduction starts when the NTC resistance measured by Ozone is around 10k Ω . This is the key parameter to take in consideration to choose the more appropriate NTC to realize the required Current Reduction behavior.

For example if the Current Reduction has to start from around 75-80°C, a NTC with 10k Ω -12k Ω @ 80°C has to be chosen.

Here below you can find some examples that use SMD NTC devices produced by Epcos; of course Epcos Codes mentioned are only for a design reference. In fact different Epcos codes or NTC produced by other manufacturers can be used and the diagram of the Current Reduction Vs NTC Temperature (see Figures 5 and 6) is always obtained starting from Figure 4 and considering the R(T) characteristic of the chosen thermistor.

Ozone design produces a knee in the output current regulation at approximately 75°C when it operates with the Epcos Code B57471V2104J062 (100 k Ω @ 25°C) as shown in Figure 5.

At temperatures less than 75°C, the temperature sense input has no effect on the driver output current ($I_{out}=100\%I_{set}$); as the NTC temperature rises above 75°C, the output current of the driver begins to drop resulting in LED temperature reduction.

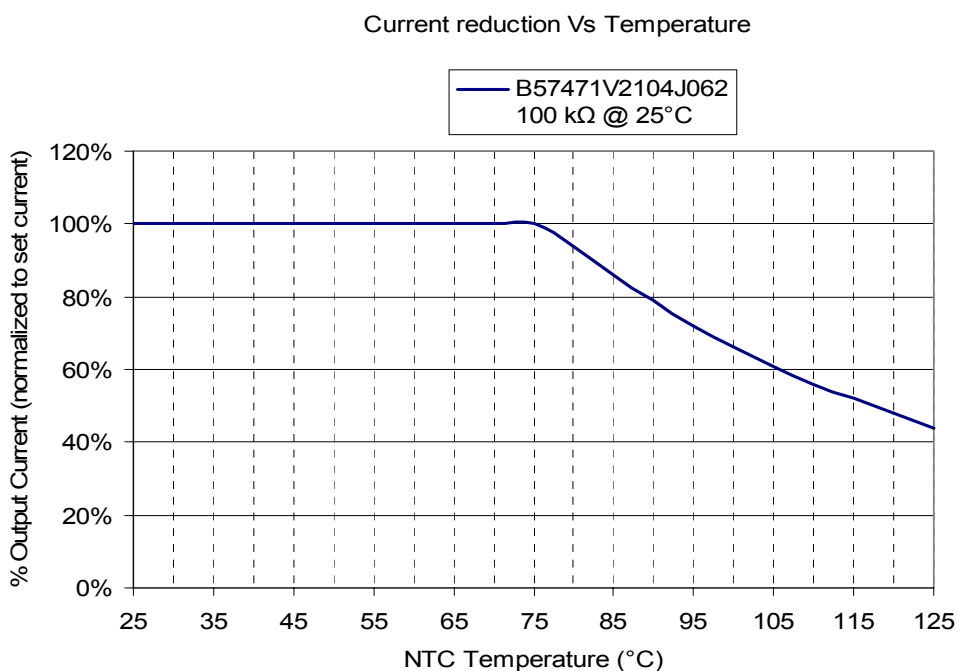


Figure 5: Output Current (%) along NTC Temperature

The graphic represented in Figure 5 refers to the current reduction caused only by the LED Over Temperature protection. The effect of the current reduction due to dimming is excluded (Dimming=100%).

Of course the changing of the nominal value of the NTC @25°C (typically this parameter is indicated as R_{25} in the NTC datasheets) generates a different current reduction behavior in particular with a different derating starting point (knee). The following section clears up how to do it.

Changing the Current Reduction behaviour by using a different NTC

If a current reduction with a different knee is required, it can be easily obtained by choosing a NTC with a different nominal resistance value @ 25° C (R_{25}).

The graph depicted in Figure 4 can be used to determine the required resistance characteristics of alternate NTC resistors; the general rule that comes from it is that if a knee at lower temperature is required, then the resistance value @25°C has to be reduced, whereas if a knee with a higher temperature is admitted then the R_{25} value has to be increased.

For example the Figure 6 shows the different curves depending on different NTC used. Starting from the NTC used in the Figure 5 (B57471V2104J062 (100k Ω @ 25°C), if a lower maximum PCB temperature is required, a NTC with lower R_{25} has to be used.

For example, the Epcos NTC code B57471V2473J062 (47k Ω @25°C) produces a curve with a knee at around 55°C; the device code B57471V2333J062 (33 k Ω @25°C) produces a curve with a knee at around 45°C and so on, as shown in the Figure 6 below.

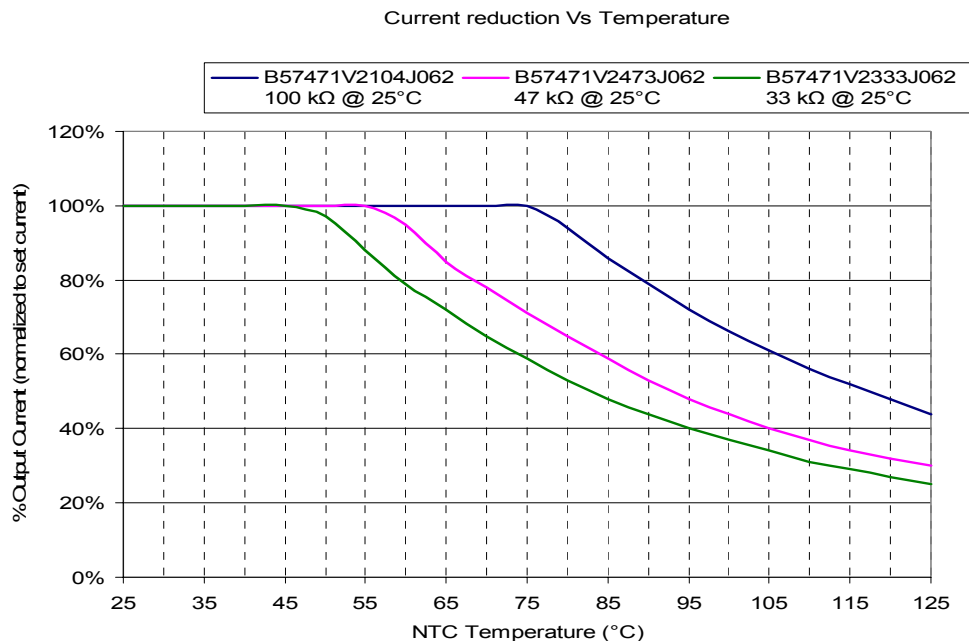


Figure 6: Output Current (%) along Temperature, by using different NTC Thermistors (Epcos)

Generally moving from one code to another to change the R_{25} value, the size case of the NTC can remain the same (in this case a 0805 size has been selected), so that the LED Board layout is not required to be modified.

The graphics showed in the Figure 6 refer to the current reduction caused only by the LED Over Temperature protection. The effect of the current reduction due to dimming is excluded (Dimming=100%).

All the examples mentioned above use Surface-mount NTC thermistors (Epcos, **Series B574**V2**).

Alternatively, Epcos offers a similar thermistors (**Series B57703M**), specifically designed for Surface temperature measurement, e.g. on housings and heat sinks, with a probe assembly (see Figure 3), useful to measure the temperature close to LEDs in non-SMD applications.

The method explained above that allows to obtain the Current Reduction Vs NTC Temperature diagram (see Figures 5 and 6) is valid regardless of the NTC used.

In the non-SMD applications also the NTCs Series **NTCALUG**, produced by Vishay are designed to be fixed directly to the LED Board heatsink.

0-10V or 1-10V dimming

By controlling the voltage at the dimming input between 1V and 10V or between 0V and 10V, the output current of the driver will change linearly from 10% to 100% of the current set (Iset). Usually White LED Light applications require a linear dimming.

Nevertheless in some case where there are stringent requirements in terms of CCT stability, the solution is the adoption of a PWM Dimming. In that case please refer to the Application Note 4 "[AN4_Ozone DALI & PWM Dimming](#)".

The Dim inputs can be connected in parallel with other Ozone drivers to enable control of multiple fixtures from a single control point.

The driver includes an internal pull-up; therefore if no connection is made to the dimming input, the driver will operate at the nominal set point ($I_{out}=100\%I_{set}$). If the dimming input (0-10V Dimm) is shorted to the RTN, the output current will be 10% of the current set ($I_{out}=10\%I_{set}$). The external dimming control is not required to inject current into the driver but must be capable of sinking current (100uA) provided by the driver at the dimming input connection. If the external dimming control does provide a 0-10V source, it must also be capable of sinking the current from the dimming input.

Figure 7 is a graph showing the output current versus the Voltage at the dimming input. The output current is normalized to 100% of the current set (100% means $I_{out}=100\%I_{set}$).

Output Current Vs Dimming input voltage

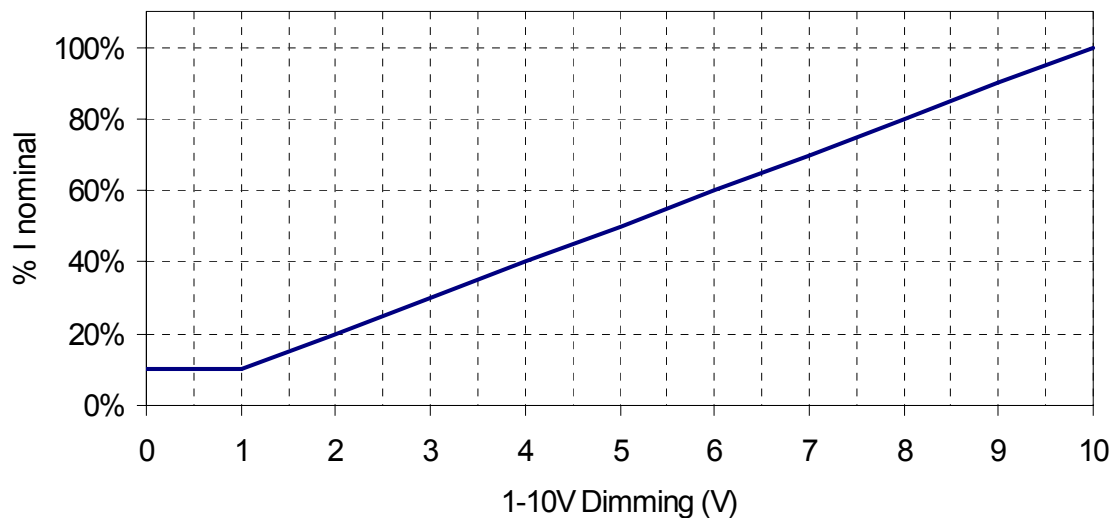


Figure 7: Output Current (%) along dimming input voltage

Dimming options

Ozone LED driver accepts various control options to dim the output current. The following table summarizes the most common configurations along with the corresponding electrical requirements.

Interface	Circuitry	Requirements / Limitations
Variable Resistor		Resistor range of <10Kohms to reduce output current to 10% and >90K ohms to achieve 100% current. Refer to Figure 8 for a graph of output current versus value of the resistor for a single driver.
Adjustable Power Supply		Power supply must be capable of sinking 100uA from each driver. If multiple drivers are to be connected to a single power supply, the Power Supply must be capable of sinking 100uA per driver.
0-10V or 1-10V Wall Dimmer		0-10V and 1-10V dimmers are not well characterized. Therefore, performance may vary between manufacturers. As additional drivers are added to a single dimmer, the dimming value may change due to the increased current into the dimmer. If multiple drivers are to be connected to a single Dimmer, the Dimmer must be capable of sinking 100uA per driver.

Figure 8 shows the relationship between the value of the resistor connected across the dimming input versus the output current of a single driver.

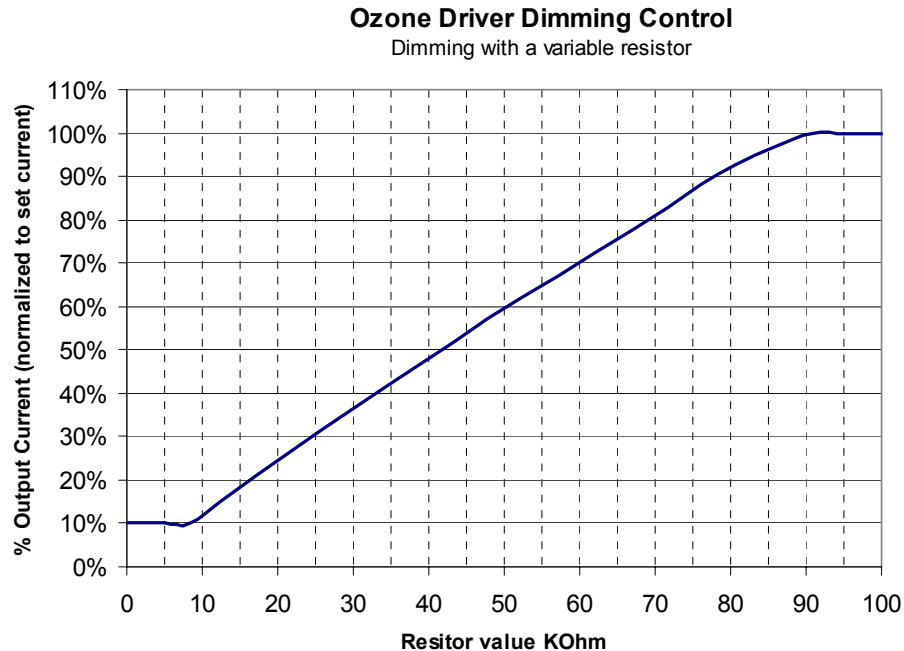


Figure 8: Output Current (%) along Resistance value connected to the dimming input.

When using a power supply, control equipment/circuitry or similar device, care must be taken to ensure the equipment is isolated from the AC power source. If the dimming connections are to be wired as a Class II circuit, all connected equipment must have the appropriate safety approvals for Class II circuits.

When connecting multiple drivers to a single control device, it must be appropriately rated and capable of sinking 100uA of current from each connected driver. As the number of drivers increase, the dimming performance characteristics may change due to the increased current into the dimming control circuitry (depending on the characteristics of the external circuit).

The length of the dimming circuit wiring, wire size and the number of drivers connected to the dimming control must be designed so that the total voltage drop is less than 0.2-0.3V between the drivers and the dimming control.

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Introduction

Ozone LED Driver stands for an extremely flexible LED Driver, Designed for fast and easy configuration.

This Application Note “AN3_Ozone Setting” illustrates the setting options of the Ozone LED driver in order to allow a fast and easy setting, performed by the lamp manufacturer and /or installer.

An external dedicated and portable programming tool (available as optional, ordering code: RSOZ070-PTOOL), permits to customize different Ozone LED driver key parameters. This guarantees extreme flexibility during final products (lamps) production process, because all OEMs will be able to directly personalize their products during the production process, avoiding managing different LED driver models and their stocking inventory.

In addition to the several benefits that this feature allows during the production process, it permits also to operate directly in the lamp installation field, avoiding wasting of time due to product’s replacement.

Ozone Programming Tool

The battery powered unit (see Figure 1), is a user friendly remote programmer that permits the user to manage the following settings:

- Output Constant Current Setting
- Light Fade Time Setting
- DALI communication enabling/disabling.
- PWM dimming enabling/disabling.



Figure 1: Ozone Programming Tool (Code RSOZ070-PTOOL)

Programming Connections

The Ozone programming tool is easily connectable with Ozone LED driver by the 3-wire cable (Figure 2). The cable is included in the Code RSOZ070-PTOOL)

The three programming wires are selectable by coloured collars near the metal end terminal. Follow the connection table below for a correct programming connections correspondence, between programming wires and Ozone output connector pins involved.

Programming Wire	Ozone OUTPUT connector pin
RED collar wire	Ts
BLACK wire	RTN
WHITE collar wire	0-10V Dimm

Table 1: Ext. programming tool connections correspondence

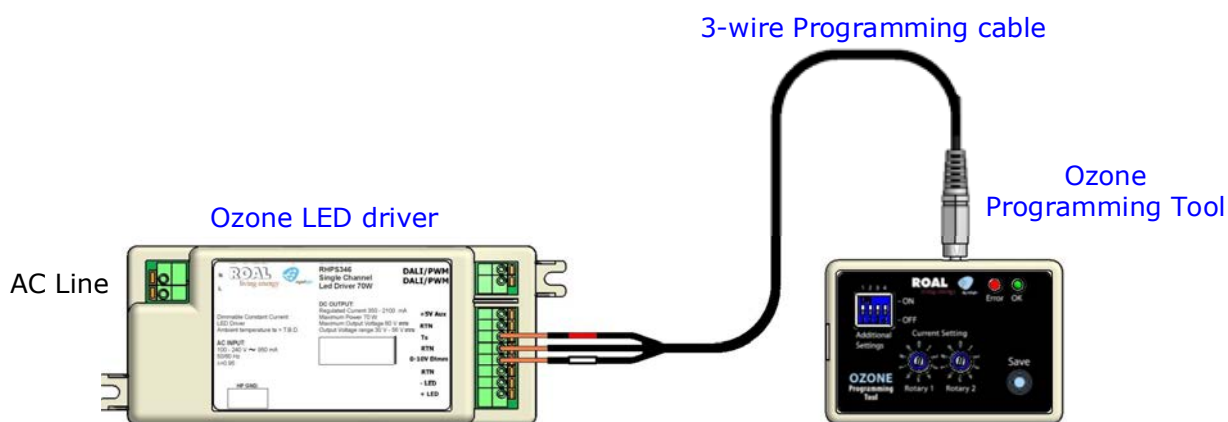


Figure 2: Ozone Programming Tool connection

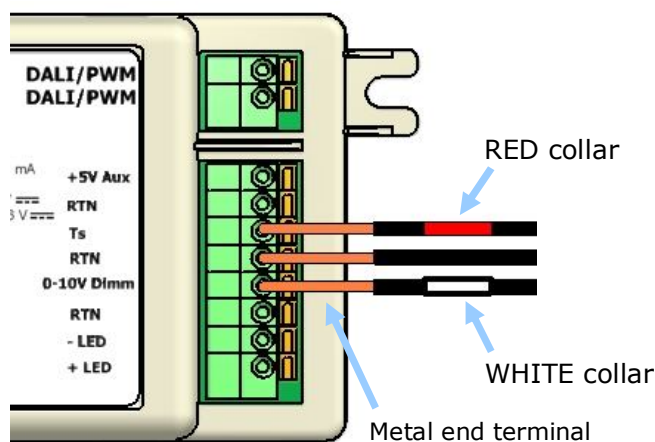


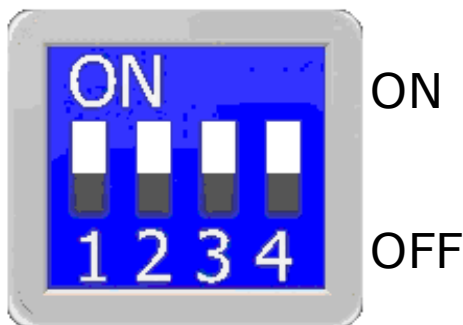
Figure 3: Programming wires connection to the LED Driver

Dip-switch settings (Fading, DALI, Dimming)

The 4-position dip-switch on the remote programming tool permits to set the light fade time in addition to DALI/PWM enabling/disabling.

Follow the dip-switch settings combination table (Table 2) below to select the requested configuration.

Each switch can stand in ON or OFF position, the combination of the four switches positions determines the product configuration as reported in the table.



Sw. 1	Sw.2	Fade time (s)
OFF	OFF	0,0
ON	OFF	2,0
OFF	ON	5,0
ON	ON	10,0
Switch 3		DALI/PWM
OFF		DALI enabled; PWM disabled
ON		DALI disabled; PWM enabled
Switch 4		Factory reserved

Blue = factory preset values.

Table 2: Dip-switch settings combinations

Fade Time: Required time (in seconds) to raise linearly the output LED current from 0A (OFF state) to the nominal set current (Iset) and vice versa.

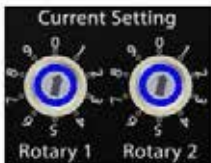
Fade Time will also affect the 0-10V linear dimming function (see "[AN2_Ozone Temperature Sense & 0-10V dimming](#)" for details).

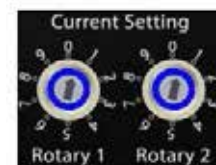
Example: Considering a 10sec. fade time: if the user dims the output current down from 100%Iset to 50%Iset, the transition time will be 5sec.

NOTE: When DALI is enabled, the fade time value can also be set by the DALI user interface. In case of DALI and 0-10V dimming being used simultaneously (to avoid) with different fade time values, the DALI fade time will affect the DALI PWM dimming and the fade time set by programming tool will affect the linear dimming. The two fade times set will be active together.

Rotary switches settings (output constant current)

By combining the two 10-way rotary switches positions, it is possible to set the output constant current value. A very wide output current range of values, from 350mA to 2100mA, can be selected in 50mA steps, for a 70W total maximum output power. See the table below to select the right rotary switches positions corresponding to the required output current.

		RSOZ070-35-Full		RSOZ070-60-Full		RSOZ070-120-Full		RSOZ070-200-Full	
Output Current Set (Iset)	Rotary Position	Vout min	Vout max	Vout min	Vout max	Vout min	Vout max	Vout min	Vout max
mA	R1 - R2	Vdc	Vdc	Vdc	Vdc	Vdc	Vdc	Vdc	Vdc
350	0-0			30	56	60	115	120	195,0
400	0-1			30	56	60	115	120	175,0
450	0-2			30	56	60	115	120	155,6
500	0-3			30	56	60	115	120	140,0
550	0-4			30	56	60	115	120	127,3
600	0-5			30	56	60	115		
650	0-6			30	56	60	107.7		
700	0-7			30	56	60	100		
750	0-8			30	56	60	93.3		
800	0-9			30	56	60	87.5		
850	1-0			30	56	60	82.4		
900	1-1			30	56	60	77.8		
950	1-2			30	56	60	73.7		
1000	1-3	20	33	30	56	60	70.0		
1050	1-4	20	33	30	56	60	66.7		
1100	1-5	20	33	30	56	60	63.6		
1150	1-6	20	33	30	56	Table 3: Output current setting table 			
1200	1-7	20	33	30	56				
1250	1-8	20	33	30	56				
1300	1-9	20	33	30	53.8				
1350	2-0	20	33	30	51.9				
1400	2-1	20	33	30	50.0				
1450	2-2	20	33	30	48.3				
1500	2-3	20	33	30	46.7				
1550	2-4	20	33	30	45.2				
1600	2-5	20	33	30	43.8				
1650	2-6	20	33	30	42.4				
1700	2-7	20	33	30	41.2				
1750	2-8	20	33	30	40.0				
1800	2-9	20	33	30	38.9				
1850	3-0	20	33	30	37.8				
1900	3-1	20	33	30	36.8				
1950	3-2	20	33	30	35.9				
2000	3-3	20	33	30	35.0				
2050	3-4	20	33	30	34.1				
2100	3-5	20	33	30	33.3				



Important Note:

The maximum allowed 70W output power must not be exceeded under any condition.

Highlighted values in the table are the factory preset output current values, which correspond to the maximum output voltage value allowed for each Ozone model. For any higher output current value, the corresponding output voltage range will be proportionally reduced in order not to exceed the 70W maximum output power, as shown in this table.

2150	3-6	20	32,6
2200	3-7	20	31,8
2250	3-8	20	31,1
2300	3-9	20	30,4
2350	4-0	20	29,8
2400	4-1	20	29,2
2450	4-2	20	28,6
2500	4-3	20	28,0
2550	4-4	20	27,5
2600	4-5	20	26,9

Programming operations sequence

Run the following 10-step sequence for Ozone LED driver programming, using the "RSOZ070-PTOOL" external programming tool.

1. If connected, unplug AC power from the Ozone input AC connector.
2. If connected, unplug all wires from the secondary connectors (DALI, LED board, +5Vaux, Ts).
3. Connect the 3-wire cable of the external programming tool to the Ozone output connector, as shown in Figure 2 and 3.
4. Reconnect the AC power to the Ozone input AC connector.
5. Select and run the correct Dip-switch settings combinations according to Table 2.
6. Choose the output Constant Current value and place the correspondent rotary switches positions, according to Table 3.
7. Press "Save" push button.
8. Verify the feedback green LED blinks (2 fast blinks followed by 1 longer blink).
9. Verify that the error red LED remains OFF after the green LED blinking.
10. First disconnect the AC cable and then the 3-wire programming cable from the Ozone output connector.

Now the new settings are installed and they will be active at the next Ozone power-on.

WARNINGS:

If the error red LED turns-on after the two green LED fast blinks, it means that the programming operation failed.

In this case, repeat the programming sequence from the beginning paying particular attention to wires connections and rotary switches combination.

Any rotary switches combination not shown in Table 3 must be considered as not allowed.

Additional red LED fast blinks after the programming phase, indicate a low battery level.

Ozone Toolset Software

The Ozone microcontroller based technology permits to implement additional features that have a main rule especially in outdoor lighting applications.

The optional programmable functions are:

1. *Driver general hardware settings (PWM, DALI, current settings)*
2. *Adjustable Dimmer function*
3. *Constant Light function*

These features can be programmed and stored in the Ozone Programming Tool by connecting it to a laptop with a USB cable, and using the dedicated [Ozone Toolset Software](#) (provided with the Ozone Programming Tool).

See "[UM1_Ozone Toolset Software Manual](#)" for further details.

Warranty

ROAL Electronics S.p.A. (ROAL) warrants the Ozone Programming Tool (Code RSOZ070-PTOOL) against defects in materials and workmanship under normal use by the original purchaser for one hundred eighty (180) days after the date of purchase. ROAL makes no other express warranties.

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Mechanical dimensions and battery replacement

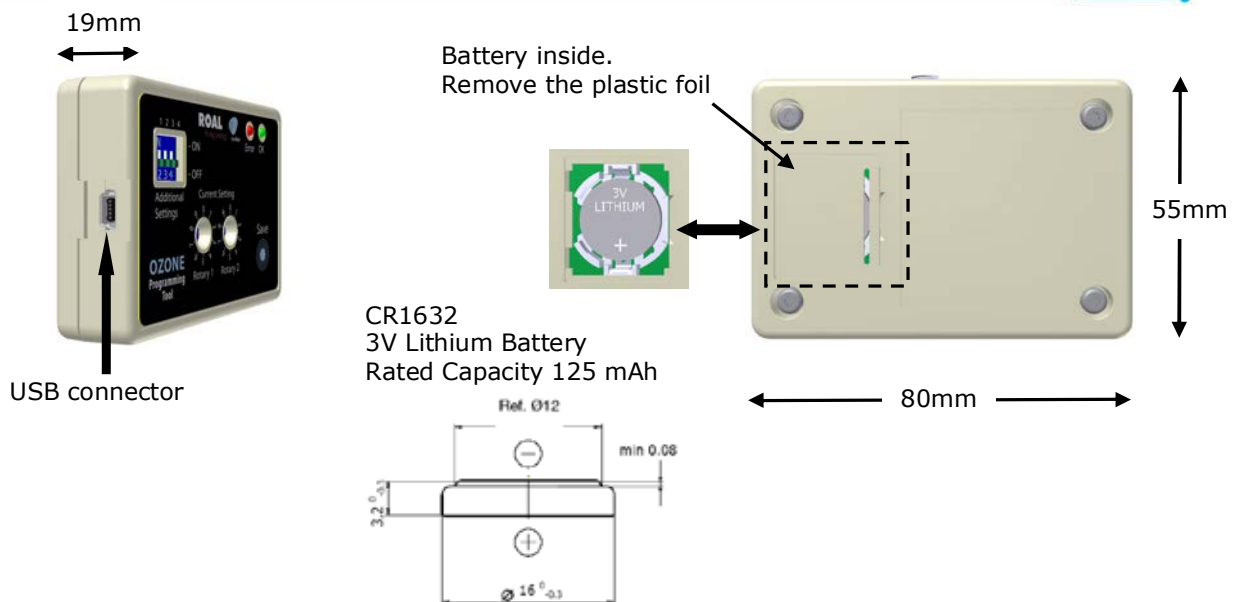


Figure 4: Mechanical Dimensions and battery replacement

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Introduction

DALI (Digital Addressable Lighting Interface) is a standard digital communication protocol, used to link electronic light units. It is a standard spotlight management system.

A DALI network can be used to drive building lighting systems or more simple lighting networks like some spotlights in a single room or in a shop where it is useful to drive each light source individually.

A DALI system is cheap, simple and flexible. Minimal wiring and user friendly functions are the main characteristics of this digital communication protocol. It is used to close the gap between more simple analog dimming techniques (like 0-10V or Triac) and more complex digital bus communications.

It could be also implemented as a subsystem in a more complex digital bus building network.

The DALI standard is defined in the IEC 62386 international norm, which guarantees compatibility between products from different manufacturers and various types of devices.

Ozone LED Drivers equipped with the DALI Option are compatible with DALI STANDARD (IEC 62386) and can be used in a DALI network.

Typical Applications

Every Place where energy optimization and lighting scenes are required, such as:

- Shopping Centre
- Conference Rooms
- Sports Centres
- Home
- Outdoor Applications
- Theatres
- Daylight public system management
- Presence detection lighting systems
- Aesthetic light effects

DALI Main Features

- Easy Wiring:

Standard low-cost wires can be used, the control line (2 wires) can be laid together with the power AC line (same multi wires cable or sheath) without risks.

- No polarity:

No need to distinguish wires polarity, there is not polarity on the DALI control line.

- Flexibility:

Devices can be removed or added at any time from/in an existing network. Devices connection can be serial, parallel, or mixed. Each device can be managed independently or in groups, set by software.

Lighting scenes can be created.

- ON/OFF and Dimming:

All devices can be managed as slaves by a control unit (master), and can be turned on/off or dimmed independently or in groups.

Logarithmic or linear dimming.

- Device status:

Fault feedback can be released from OZONE-DALI faulty devices.

DALI Technical & Electrical Features

Max. n. of DALI units in a network: 64

Max. n. of DALI device's group in a network: 16

Max. n. of scenes in a DALI system: 16

DALI bus voltage: 9.5V-22.5V 16V typ.

DALI bus current: 250mA MAX.

DALI control gear Max current consumption: 2mA

Data transfer rate: 1200 bit/sec.

Max. DALI bus cable length: 300m for 1.5mm² cable section (2V drop must not be exceeded along the bus line under any condition).

Ozone-DALI Connection

Ozone-DALI LED Driver versatility, allows the user to approach different connections and management solutions as shown in the example below.

Each Ozone-DALI control gear can be part of more groups at the same time, without conflicts.

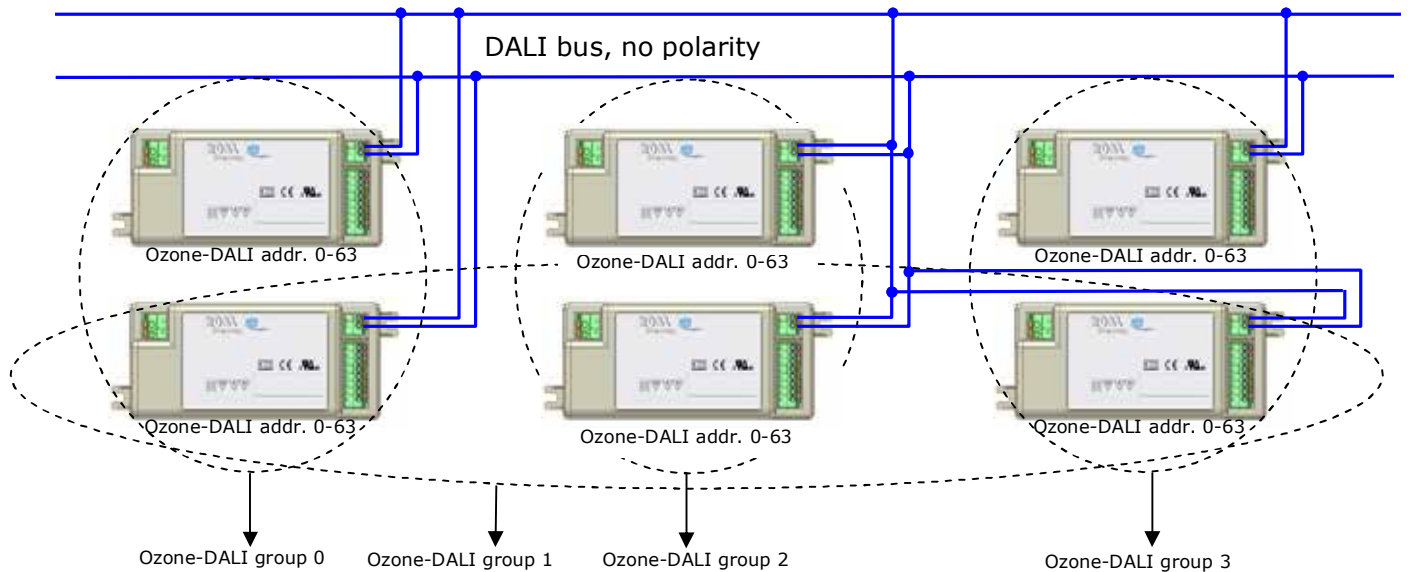


Figure 1: Ozone-DALI network (example connection)

Ozone-DALI Declaration of Factory variables

Variable	Default Value (Factory pre-set)	Reset Value
ACTUAL LEVEL	Max Level (254)	254
POWER ON LEVEL	Max Level (254)	254
SYSTEM FAILURE LEVEL	Max Level (254)	254
MIN LEVEL	Physical min. level	Physical min. level
MAX LEVEL	254	254
FADE RATE	7	7
FADE TIME	0	0
SHORT ADDRESS	255 (no address)	No change
GROUP 0-7	No group	No group
GROUP 8-15	No group	No group
SCENE 0-15	No scene	No scene
VERSION NUMBER	1	No change
PHISICAL MIN. LEVEL	1	No change

For any additional details please refer to the IEC 62386 international standard.

Ozone-DALI Implemented Commands

Direct arc power control command

Number	Command Name	Description
-	DIRECT ARC POWER CONTROL	The actual light level will be set to the value given by the data byte using the actual FADE TIME.

Indirect arc power control commands

Number	Command Name	Description
0	OFF	The lamp goes to OFF without fading.
1	UP	The lamp is dimmed up for 200ms using the selected FADE RATE. If the lamp is already at the MAX LEVEL, no change will be implemented. If this command is received again while it is being executed , It will be retriggered. If the lamp is in OFF state, this command shall not cause the lamp turn ON.
2	DOWN	The lamp is dimmed down for 200ms using the selected FADE RATE. If the lamp is already at the MIN LEVEL, no change will be implemented. If this command is received again while it is being executed , It will be retriggered. This command shall not cause the lamp turn OFF.
3	STEP_UP	The actual light level will be set one step higher without fading. There shall be no change if the light level is already at the MAX LEVEL. This command shall not cause lamps to be switched ON.
4	STEP_DOWN	The actual light level will be set one step lower without fading. There shall be no change if the light level is already at the MIN LEVEL. This command shall not cause lamps to be switched OFF.
5	RECALL_MAX_LEVEL	The actual light level will be set to the MAX LEVEL without fading. If the lamp is OFF it shall be switched ON with this command.
6	RECALL_MIN_LEVEL	The actual light level will be set to the MIN LEVEL without fading. If the lamp is OFF it shall be switched ON with this command.
7	STEP_DOWN_AND_OFF	The actual light level will be set one step lower without fading. If the actual light level is already at the MIN LEVEL, the lamp shall be switched OFF by this command.
8	ON_AND_STEP_UP	The actual light level will be set one step higher without fading. If the lamp is switched OFF, the lamp shall be switched ON by this command and shall be set to the MIN LEVEL.
16-31	GO_TO_SCENE	Set the actual light level to the value stored for scene xx (0 to 15) using the actual fade time. If a control gear (a lamp) does not belong to the called scene x, its status shall remain unchanged.

Configuration commands		
Number	Command Name	Description
32	RESET	The variables in the memory shall be changed to their reset values. InserireTabella variabili.
33	STORE_ACTUAL_LEVEL_IN_THE_DTR	The actual light level shall be stored in the DTR (Data Transfer Register).
42	STORE_THE_DTR_AS_MAX_LEVEL	The value in the DTR shall be saved as the new MAX LEVEL. If this value is below the MIN LEVEL of the control gear then the MIN LEVEL shall be stored as the new MAX LEVEL. If the ACTUAL LEVEL is above the new MAX LEVEL it should be set to the new MAX LEVEL without fading. If the DTR is MASK then 254 shall be stored as MAX LEVEL.
43	STORE_THE_DTR_AS_MIN_LEVEL	The value in the DTR shall be saved as the new MIN LEVEL. If the ACTUAL LEVEL is below the new MIN LEVEL it should be set to the new MIN LEVEL without fading, but if the ACTUAL LEVEL is "0" (OFF) it should not be affected by this command.
44	STORE_THE_DTR_AS_SYSTEM_FAILURE_LEVEL	The value in DTR shall be saved as new SYSTEM FAILURE LEVEL.
45	STORE_THE_DTR_AS_POWER_ON_LEVEL	The value in DTR shall be saved as the new POWER ON LEVEL.
46	STORE_THE_DTR_AS_FADE_TIME	The FADE TIME "T", will be set to a value given by formula : $T = \frac{1}{2} \cdot \sqrt{2^X} \cdot 1s$ with X=1-15 (X=0 means no fade). FADE TIME: Time for changing the actual light level to the requested level. The FADE TIME is used by the DIRECT ARC POWER CONTROL and GO TO SCENE commands.
47	STORE_THE_DTR_AS_FADE_RATE	The FADE RATE "F" will be set to a value given by the formula: $F = \frac{506}{\sqrt{2^X}} \text{ steps/s}$ with X=1-15 FADE RATE: Rate in steps/s for changing the actual light level to the requested level. The FADE RATE is used by the UP and DOWN commands.
64-79	STORE_THE_DTR_AS_SCENE_XXXX	The value in the Data Transfer Register will be stored as a new level for the scene X (0-15).

System parameters settings		
Number	Command Name	Description
80-95	REMOVE_FROM_SCENE_XX	The control gear will be removed from scene XX
96-111	ADD_TO_GROUP_XX	The control gear will be added to group XX
112-127	REMOVE_FROM_GROUP_XX	The control gear shall be removed from group XX
128	STORE_DTR_AS_SHORT_ADDRESS	The value in the DTR shall be saved as new short address.

Query commands: Queries related to status information		
Number	Command Name	Description
144	QUERY_STATUS	Status information request.
145	QUERY_CONTROL_GEAR	Ask if there is a control gear with the given address that is able to communicate. The answer is YES or NO.
146	QUERY_LAMP_FAILURE	Ask if there is a lamp problem at the given address. The answer is YES or NO.
147	QUERY_LAMP_POWER_ON	Ask if there is a lamp operating at the given address. The answer is YES or NO.
148	QUERY_LIMIT_ERROR	Ask if the last requested light level at the given address could not be met, because it is above the MAX LEVEL or below the MIN LEVEL. The answer is YES or NO.
149	QUERY_RESET_STATE	Ask if the control gear is in RESET STATE. The answer is YES or NO.
150	QUERY_MISSING_SHORT_ADDRESS	Ask if the control gear has no short address. The answer is YES (no short address) or NO.
151	QUERY_VERSION_NUMBER	The answer is 1.
152	QUERY_CONTENT_DTR	The answer is the content of the DTR as an 8-bit number.
153	QUERY_DEVICE_TYPE	The answer is the device type as an 8-bit number (6).
154	QUERY_PHYSICAL_MINIMUM_LEVEL	The answer is the PHYSICAL MINIMUM LEVEL as an 8-bit number.
155	QUERY_POWER_FAILURE	The answer will be YES if the control gear has not received a RESET or one of the following arc power control commands since the last power-on: DIRECT ARC POWER CONTROL, OFF, RECALL MAX LEVEL, RECAL MIN LEVEL, STEP DOWN AND OFF, ON AND STEP UP, GOTO SCENE.

Queries related to arc power parameter settings		
Number	Command Name	Description
160	QUERY_ACTUAL_LEVEL	The answer will be the actual light level .
161	QUERY_MAX_LEVEL	The answer will be this level as an 8-bit number.
162	QUERY_MIN_LEVEL	The answer will be this level as an 8-bit number.
163	QUERY_POWER_ON_LEVEL	The answer will be this level as an 8-bit number.
164	QUERY_SYSTEM_FAILURE_LEVEL	The answer will be this level as an 8-bit number.
165	QUERY_FADE_TIME_AND_RATE	The answer will be xxxx yyyy where xxxxis the FADE TIME and yyyy the FADE RATE.

Queries related to system parameter settings

Number	Command Name	Description
176-191	QUERY_SCENE_LEVEL_XXXX	The answer will be the light level of scene XX as an 8-bit number.
192	QUERY_GROUPS_0_7	The answer will be the membership of groups 0-7 as an 8-bit value.
193	QUERY_GROUPS_8_15	The answer will be the membership of groups 8-15 as an 8-bit value.
194	QUERY_RANDOM_ADDRESS_H	The answer will be the 8 high bits of the random address.
195	QUERY_RANDOM_ADDRESS_M	The answer will be the 8 mid bits of the random address.
196	QUERY_RANDOM_ADDRESS_L	The answer will be the 8 low bits of the random address.

Application extended commands for LED drivers

Number	Command Name	Description
227	SELECT_DIMMING_CURVE	Set the dimming curve to linear or to logarithmic.
228	STORE_THE_DTR_AS_FAST_FADE_TIME	The DTR content will be stored as fast fade time value.
237	QUERY_GEAR_TYPE	Answer will be "Led power supply integrated" and "a.c. supply possible".
238	QUERY_DIMMING_CURVE	Answer will be the dimming curve currently in use.
239	QUERY_POSSIBLE_OPERATING_MODES	Answer will be an 8-bit code that identifies the following possible operating modes: PWM mode, AM mode, C.C. output.
240	QUERY_FEATURES	Answer will be an 8-bit code , giving information about implemented optional features.
241	QUERY_FAILURE_STATUS	Answer will be an 8-bit code identifying the actual failure status.
242	QUERY_SHORT_CIRCUIT	Ask if there is a short circuit detected at the given address. Answer shall be yes or no.
243	QUERY_OPEN_CIRCUIT	Ask if there is an open circuit detected at the given address. Answer shall be yes or no.
247	QUERY_THERMAL_SHUTDOWN	Ask if there is a thermal shut down detected at the given address. Answer shall be yes or no.
248	QUERY_THERMAL_OVERLOAD	Ask if there is a thermal overload with light level reduction detected at the given address. Answer shall be yes or no.
252	QUERY_OPERATING_MODE	Answer will be an 8-bit code that identifies the following possible operating modes: PWM mode, AM mode, C.C. output.
253	QUERY_FAST_FADE_TIME	Answer shall be the Fast Fade Time as an 8-bit value.
254	QUERY_MIN_FAST_FADE_TIME	Answer shall be the Minimum Fast Fade Time as an 8-bit value.
255	QUERY_EXTENDED_VERSION_NUMBER	Answer will be 1.

Special commands: Terminate special processes		
Number	Command Name	Description
256	TERMINATE	Special mode processes shall be terminated.

Download information to the DTR		
Number	Command Name	Description
257	DATA_TRANSFER_REGISTER (DTR)	The 8-bit value xxxx xxxx shall be stored to the DTR.

Addressing commands		
Number	Command Name	Description
258	INITIALISE	This command will start a 15 min. timer, the addressing commands 259 to 270 shall only be processed whilst this timer is running. The other commands shall still be processed during this period.
259	RANDOMISE	The control gear shall generate a new random address on receipt of this command.
260	COMPARE	The control gear shall compare its random address with the 24-bit search address. If its random address is less or equal the search address then the control gear shall answer YES.
261	WITHDRAW	The control gear whose random address is equal to the search address shall be excluded from the compare process, but not from the initialization process.
264	SEARCHADDR_H	The 8 high bits of the search address.
265	SEARCHADDR_M	The 8 mid bits of the search address.
266	SEARCHADDR_L	The 8 low bits of the search address.
267	PROGRAM_SHORT_ADDRESS	The control gear shall store the received 6-bit address as its short address if it is selected. Selected means that the control gear's random address is equal to the 24-bit search address.
268	VERIFY_SHORT_ADDRESS	The control gear shall answer YES if the received 6-bit short address is equal to its own short address.
269	QUERY_SHORT_ADDRESS	The control gear shall answer its short address if the random address is equal to the search address or the control gear is physically selected.

Extended special commands		
Number	Command Name	Description
272	ENABLE_DEVICE_TYPE_X	This command shall select the device type for which the next following application extended command (227 to 255) is valid.

Any command not shown in this document has not been implemented.
For any additional details, please, refer to the IEC 62386 international standard.

DALI dimming curves

Ozone-DALI ensures very high dimming performance, currently not achievable with analog dimming techniques such as 0-10Vdc or 1-10Vdc.

Ozone-DALI L.E.D. driver provides 254 brightness level between min and max values, including linear and logarithmic (default) dimming possibilities.

Output Current Vs DALI linear dimming value

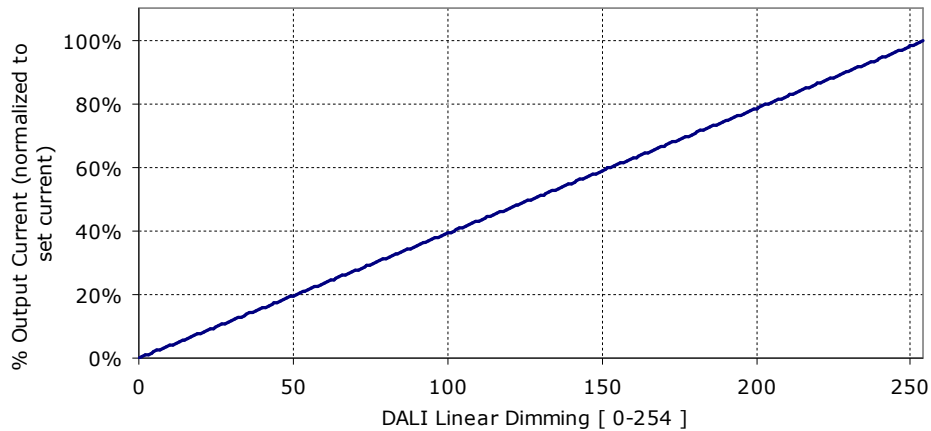


Figure 2: DALI linear dimming diagram

Logarithmic dimming technique gives larger brightness increments at high dim levels and smaller increments at low dim levels. The result is a better control of the lighting intensity in response to the human eye perception.

Output Current Vs DALI logarithmic dimming value

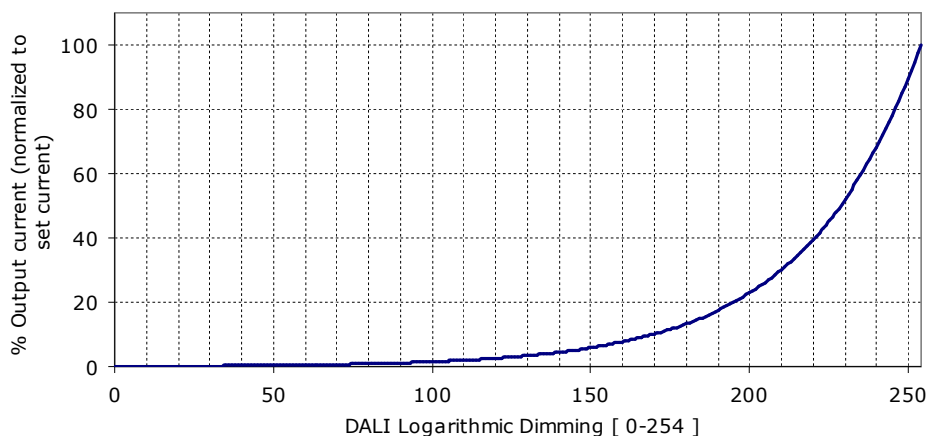


Figure 3: DALI logarithmic dimming diagram

PWM dimming

Ozone-DALI output current can also be dimmed using a PWM dimming signal applied on the same DALI connector.

Using the Ozone programming tool, available as optional (ordering code: RSOZ070-PTOOL), it is possible to set Ozone-DALI as DALI LED driver or PWM dimmable LED driver. Refer to "[AN3_Ozone setting](#)" for more device settings details.

Once set as PWM dimmable LED driver, Ozone can accept a PWM dimming signal, conforming to the EN60929 normative, to dim its nominal constant current output from 0% to 100%. The frequency of the output current is fixed at 150Hz.

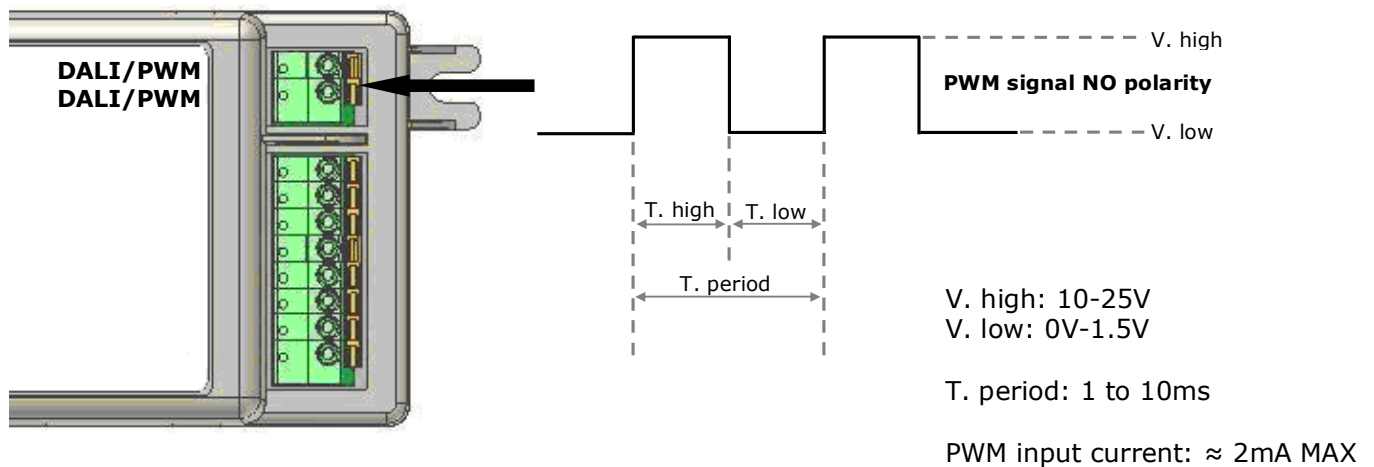
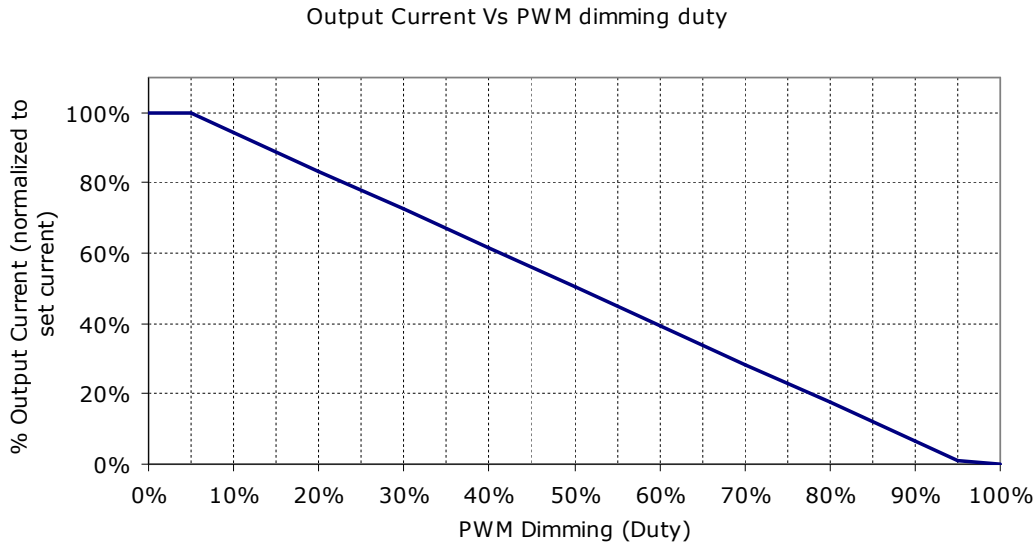


Figure 4: Ozone as PWM dimmable LED driver

Several Ozone LED drivers can be managed with the same PWM signal. The PWM generator circuitry must be able to supply the current amount required by the all connected Ozone devices (I_{tot} : $2\text{mA} \times \text{number of Drivers connected}$).

PWM dimming curve

Using Ozone as PWM dimmable LED driver, the output current level will linearly correspond to the PWM signal duty cycle as shown in the curve represented in the Figure 5.



Min Light level: 0% (OFF) when PWM Duty cycle is more than 95%
 Max Light level: 100% when PWM Duty cycle is 0-5%

Figure 5: PWM dimming diagram

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Ozone "ToolSet" PC Software User Manual



1 Introduction

The high grade of intelligence and flexibility behind OZONE led driver and the “Living Energy” philosophy undertaken by ROAL, permitted us to develop the most innovative, flexible and “environmentally friendly” constant current LED driver.

All Ozone’s settings are settable by PC software following this user manual’s instructions or by Ozone programming tool (see “[AN3 Ozone Settings](#)”).

The aim of Ozone LED driver and Ozone “Toolset” PC Software is to meet the last technologies requirements in terms of flexibility, energy saving and light optimization. Using the Ozone’s programmable features, Lighting manufacturers are now free to personalize and make their products unique.

The “Adjustable dimmer” function permits a fast and easy custom outdoor lighting management planning up to five (5) dimming levels for a custom night-light profile, worldwide time zones synchronized. Focused on large areas lighting applications, like parking lots, shopping centers and urban spaces, it allows companies or public organizations to optimize their costs taking care of the environment.

Just turning the lighting fixture ON/OFF with a photocell on the AC input, the custom light profile shape will be self-synchronized to the real time zone, without any clock setting in the installation area.

The “Constant Light” function permits a guaranteed constant light flux along the entire product life-cycle, compensating the LED’s efficiency loss due to the product aging.

By USB connection, all customized settings can be transferred to the Ozone Programming Tool (see “[AN3 Ozone Settings](#)”) and then installed in the Ozone LED driver memory to be executed.

2 Minimum PC Requirements and License agreement

2.1 Operating System: Windows XP SP3 / Windows Vista / Windows 7
Microsoft.NET Framework 4 Client Profile (x86 and x64)

2.2 The Ozone "Toolset" PC Software is property of ROAL Electronics S.p.a. and it is managed and distributed only by ROAL.

- The Ozone "Toolset" PC Software can be installed in any number of computers.
- The Ozone "Toolset" program file can not be modified in any way.
- The Ozone "Toolset" can only be distributed or sold exclusively by ROAL Electronics S.p.a.

The Ozone "Toolset" PC Software and related documentation are provided without any kind of warranty. This software does not warrant that its functions or documentation will meet your requirements or that the software operation will be error-free or complete, or that defects in the software or documentation will be corrected.

Under any circumstances, including negligence, the Ozone "Toolset" PC Software and related documentation shall not be liable for any lost revenue or profits or any incidental, indirect, special, or consequential damages that result from the use or inability to use the Software or related documentation.

3 Software installation procedure

3.1 Unzip "Ozone Toolset Vx_x" Files.zip in your dedicated PC folder, two subfolders will be generated "Ozone Toolset" and "usb Driver".

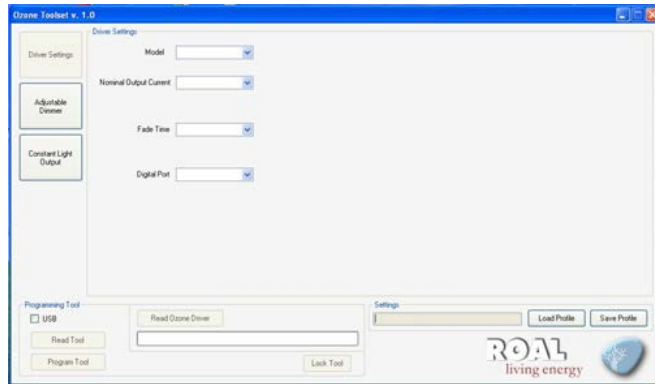
3.2 Enter the "Ozone Toolset" folder and launch the "Setup" file.

It is required to install the "Microsoft .NET Framework 4 Client Profile (x86 e x64)" in your PC system. If it is already installed in your computer, the procedure will automatically continue. If not, the installation procedure will directly download it from the Microsoft website (it could take some minutes and requires the system restart).

3.3 Once the Microsoft .NET Framework 4 is installed, or skipped if already present, Click "install" in the following window.



3.4 The Ozone "ToolSet" Software will be automatically launched at the end of the installation procedure.



A new dedicated desktop icon and Start menu folder will be created for direct software execution.

4 USB driver and Ozone Programming Tool installation procedure

4.1 Enter the "usb driver" folder (included in the "Ozone Toolset" Files.zip) and launch the Setup file

4.2 If you have User Account Control enabled (Windows Vista or Windows 7), click "Yes" or "Continue" in the window that will appear on the screen.

4.3 Wait until the installation procedure ends.

4.4 Connect the Ozone Programming Tool to the USB PC port and follow all the instructions to complete the driver setup.

5 Software update

5.1 Uninstall the old software version.

Go to: Start→Control Panel→Programs and Features→ Ozone Toolset→Click "Uninstall/Change" button.

5.2 Install the new software version, following the procedure from section 3.

6 Connections

To operate with Ozone "Toolset" Software, connect your PC to the Ozone programming tool by USB, then use the custom 3-wire cable (included in the programming tool package) to connect the programming tool to the Ozone LED driver.

The following connections will permit the user to:

- Transfer all settings from PC to the Programming Tool
- Transfer all settings from Programming Tool to Ozone
- Read all settings installed in the Programming Tool
- Read all settings installed in the Ozone LED driver



Once all settings are saved into the Ozone Programming Tool, Ozone "Toolset" Software is not necessary anymore, see "[AN3 Ozone Settings](#)" for details.

Push "Save" button (M) to transfer all settings from Programming Tool to Ozone LED driver.

The Programming Tool is a battery powered unit. It can be used as remote programmer that allows the user to set the Ozone LED Driver directly in the field or during the production process without PC.

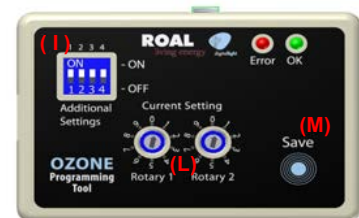
6.1 Programming Tool operative modes

• Locked Mode:

Dip (I) and rotary (L) switches are disabled.
Prog. Tool can be programmed only by Ozone "Toolset" PC software.
Settings can't be manually modified.

• Unlocked Mode:

Dip (I) and rotary (L) switches are enabled (see "[AN3 Ozone Settings](#)").
Prog. Tool can't be programmed by Ozone "Toolset" software.
Settings can be manually modified.



7 LED Driver Settings

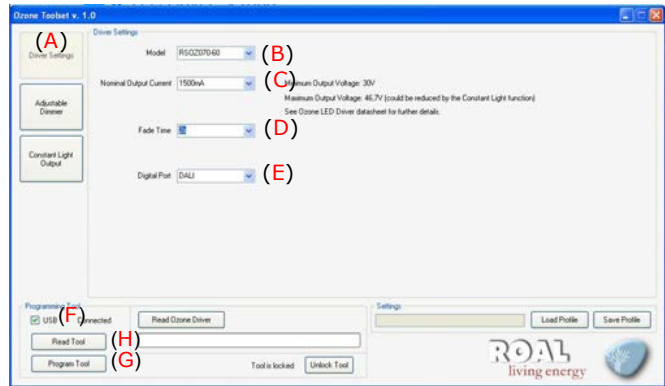
The LED Driver Settings window permits the user to set the driver's features.

Once Ozone's settings have been defined by Ozone "Toolset" Software, they have to be transferred to the programming tool in order to be installed in the Ozone LED driver and executed.

7.1 Driver Settings selection

- Select the "Driver Settings" window by pushing button (A)
- Select the driver model (B)
- Set the nominal output current* (C)
- Set the fade time (D)
- Chose the digital port function (E)

*High current settings may cause max output voltage level reduction due to power limitation (see Ozone's Data-sheet).



7.2 Programming Tool data transfer

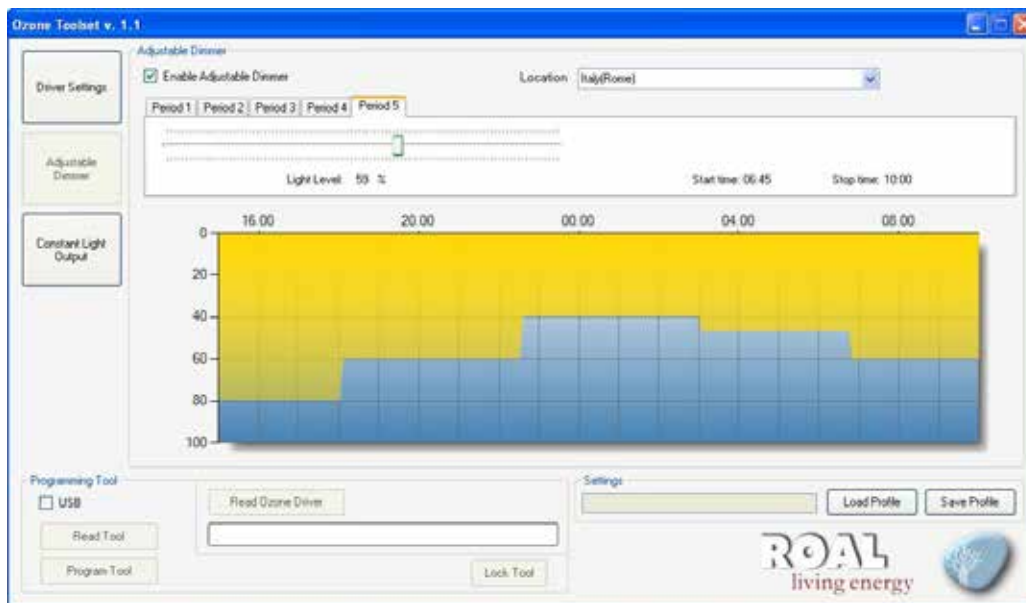
- Connect Ozone Programming Tool to the PC USB port (see paragraph 6)
- Click the USB connection to establish the communication between the PC and the Programming Tool (F)
- Push the "Program Tool" button (G)
A tool-locked/unlocked message will appear. The Programming Tool must be locked during the data transferring.
- All settings are installed in the programming tool now*
- Pushing "Read Tool" button (H) all settings stored in the Programming tool will be read and displayed in the software windows.

*Pushing (G), all enabled functions and settings will be stored in the programming tool.

8 Adjustable Dimmer Function

The Adjustable Dimmer function, useful in outdoor lighting applications, avoids the use of an external light dimmer to adjust the light flux during the entire night period with consequent energy saving. Through the Adjustable dimmer function, a custom night light profile can be set to optimize the light during the busiest hours and reducing the light (as well as power) during the low traffic hours.

A dimming profile is based on a 19 hour cycle from 15.00 hours (3pm) to 10.00 hours (10am). The software breaks this 19 hour cycle into 5 periods, each with a user settable start and stop time as well as light output as shown below.



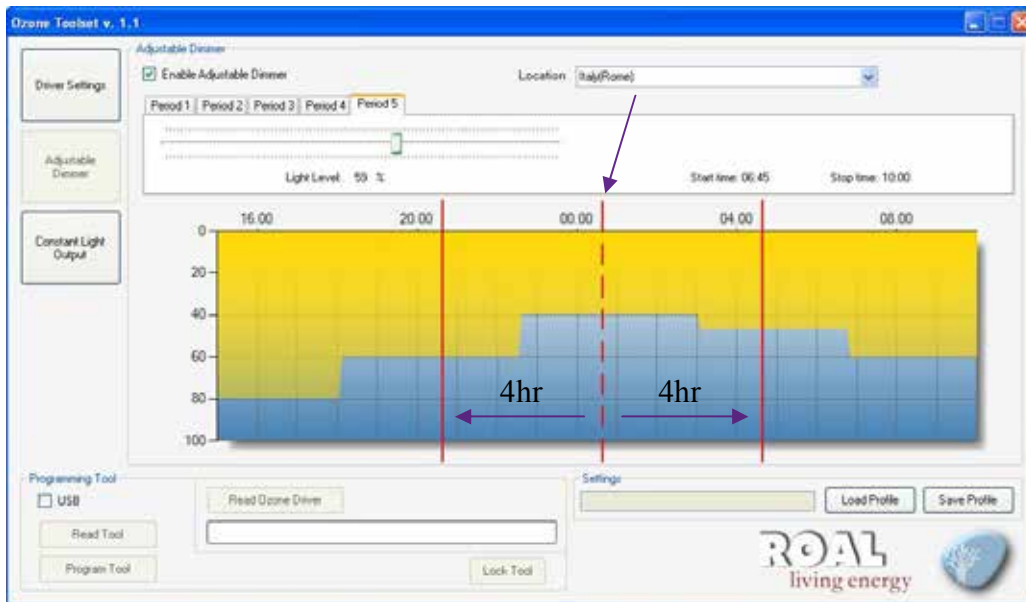
The embedded firmware in the Ozone is self-updating to determine an estimated night time without the need for an internal real time clock. This means no battery is needed and therefore no field maintenance will be requested.

The AC input to the Ozone must be controlled by an external photocell that applies power to the driver when it is dark (sunset) and removes power when light (sunrise). This enables a self-synchronization to the real time zone based on the users location entered in the software.

For the first night, when the driver is turned on via the photocell, the dimming profile will be executed starting from period 1, 15.00 hours (3pm). It will continue to run through the cycle until the driver is turned off, via the photocell. The period of time that the driver is powered is called the working time. To estimate the actual start time (sunset) and synchronize the driver, the number of hours in the working time is calculated and divided by 2, then subtracted to the midnight point placed accordingly to the set location.

The driver uses the average working time over the prior 2 days to determine the actual starting time for the next cycle. When the driver is then powered on, it resumes the cycle at the correct time.

Example: The location is set on Italy(Rome) and the midnight point is accordingly placed by the program. After the first night a working time of 8 hours is calculated. Starting from the second night the software will center the working time on the midnight point, therefore the real starting point (when the driver is turned on by the AC photocell) will be placed 4 hours before and the initial light profile will be the one set for that time. The end of the dimming operation (when the driver is turned off by the AC photocell) is similarly placed 4 hours after the midnight point.
From the third night on, the working time will be calculated as the average of the two previous working times.



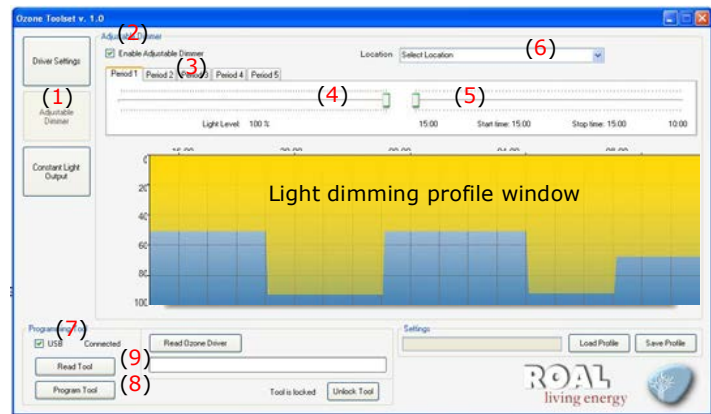
A working period longer than 19 hours is recognized as a 19 hour working time and the output of the driver will remain at the setting for period 5. A working period shorter than 3 hours is automatically discarded.

When the Adjustable Dimmer function is enabled, the 0-10V dimming signal will not affect the output current value.

The custom output current profile can be loaded or saved using the dedicated buttons. When a dimming profile is defined, it can be transferred in the Ozone Programming Tool and then installed in the Ozone LED driver memory to be executed.

8.1 Creating a new custom night light profile

- Select the Adjustable Dimmer window by pushing button (1)
- Click to Enable the function (2)
- Starting from "Period 1" up to "Period 5" (3), adjust all the light levels (between 10% and 100%)(4) and period durations (5) by using the two dedicated slide bars (the switch points cannot overlap)
- Select the location (6)
- Now you can transfer the new settings to the programming tool



8.2 Programming Tool data transfer (as explained in section 7.2)

- Click the USB connection to establish the communication between the PC and the Programming Tool (7)
- Push the "Program Tool" button (8). A tool-locked/unlocked message will appear. The Programming Tool must be locked during the data transferring
- All settings are installed in the programming tool now*
- Pushing "Read Tool" button (9) all settings stored in the Programming tool will be red and displayed in the software windows

*Pushing (8), all enabled functions and settings will be stored in the programming tool.

9 Constant Light Output Function

The Constant Light Function, available starting from Ozone firmware revision 1.4, allows to define a current compensation along the time so that the Driver increases the output current to compensate the LEDs performance depreciation.

This function allows to meet stringent requirements at LED Lamp level, when a Constant Light along the Lamp life is required.

The Output current compensation depends on the LEDs characteristics and the actual working conditions (temperatures, power, etc.). By Ozone "Toolset" Software, the Constant Light function allows to create a full customizable output current profile along the time, in order to meet all LEDs characteristics and all possible working conditions.

If this function is not used, the LED Driver provides a Constant Current output along the time.

Note: If you use the Constant Light function, the 0-10V dimming can be used at the same time.

9.1 Creating a new "Constant light" profile

- Select the Constant light window by pushing button (9)
- Click Enable the function (10)
- The custom current profile along the time is defined by filling in the (Iout/Imax)% and the timing values (11)
- The minimum Iout is 80%Imax, the max Iout is 120%Imax
- The timing scale can reach 127500hrs in 500hrs steps. Red figures indicate that they have not been defined yet (12)
- In case of replacement of a LED Driver it is possible to set the working hours of the LED Board. In case of a new LED board, the same space can be used to reset the value introducing zero hours (13)
- Now you can transfer the new Iout profile to the programming tool (see 8.2 paragraph)



The Ozone's output current profile can contain information related to the Dynamic Dimmer function or to the Constant Light function or both of them, according to the information acquired through the dedicated software windows.

Use the "Read Ozone Driver" button (16) to read the driver settings directly from the Ozone's memory and visualize them by the Ozone "Toolset" Software windows.

All settings can be saved (14) and loaded (15) as .ozt PC file.

10 Firmware and Software Revisions Overview

All the programmable features of the Ozone LED driver can be set according to the revision levels of the product's firmware, the Ozone Programming Tool and the Ozone PC Software.
The firmware revision of Ozone LED driver is indicated by a dedicated label placed above the input connector, while the revision of the Ozone Programming Tool is reported on the back side of the tool, as shown in the following pictures.



Note: No label is reported for Ozone Programming Tool at rev.1.1

The Constant Light feature has been introduced with the "Ozone Toolset v1_0" software version, and it's available for products at firmware level 1.4 or later and Ozone Programming Tool at level 1.2 or later.

For any firmware revision, the proper match with the Programming Tool and the Software revisions is reported in the following table.

Features available	Ozone firmware rev	Ozone Programming Tool rev	Ozone PC Software Pack
General hardware settings (PWM, DALI, current setpoint) & Adjustable Dimmer	1.3	1.1	"Ozone Adjustable Dimmer v1_1"
		1.2 and later (only unlocked mode; Adjustable dimmer not available)	NO

Features available	Ozone firmware rev	Ozone Programming Tool rev	Ozone PC Software Pack
General hardware settings (PWM, DALI, current setpoint) & Adjustable Dimmer & Constant Light	1.4 and later	1.1	"Ozone Adjustable Dimmer v1_1"
		1.2 and later	"Ozone Toolset v1_0" or "Ozone Toolset v1_1"